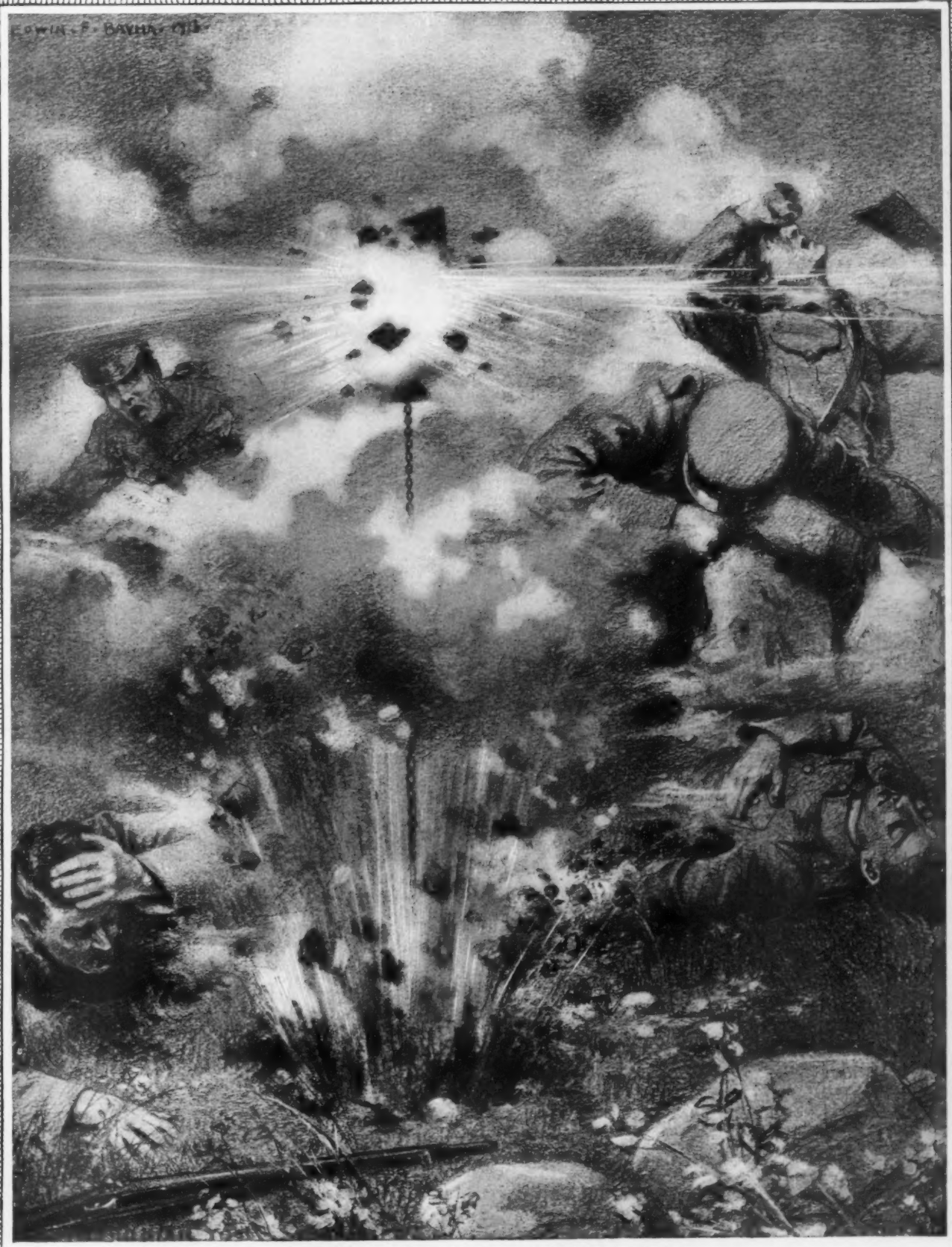
SCIENTIFIC AMERICAN



FIGHTING WITH DYNAMITE AND ELECTRICITY

Vol. CIX. No. 26
December 27, 1913

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, DECEMBER 27, 1913

Published by Munn & Co. Incorporated. Charles Allen Munn, President
Frederick Converse Beach, Secretary and Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

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Subscription Rates

Subscription one year $4.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 4.75

The Scientific American Publications

Scientific American (established 1845) . . . . . per year, $4.00
Scientific American Supplement (established 1876) . " " 5.00
American Homes and Gardens . . . . . " " 5.00
The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Unsinkable Ship

BROADLY speaking, there are two ways to safeguard the lives of the passengers against the effects of serious collision at sea. One is to crowd the upper decks with lifeboats, providing a sufficient number to accommodate everyone on board; the other is to make the ship its own lifeboat by embodying within it such construction that it is absolutely unsinkable. As representing the first method, the "Imperator" is to-day lumbered up with no less than eighty-four lifeboats, and the new "Aquitania" of the Cunard Line will come into port next summer with no less than ninety-two lifeboats on board.

The SCIENTIFIC AMERICAN has earnestly maintained that the rational way to treat this question is so to construct every large passenger ship, that in the event of serious injury, it will act as its own lifeboat and remain afloat long enough for the transfer of passengers to rescuing ships that have been summoned by wireless. In his response to the American Committee on Hulls and Bulkheads, the representatives of which are now sitting at the London International Conference, the Editor stated his convictions as follows: "It is my belief that the most effective method of protecting the stability of ships is one that is not referable to any of the above questions (asked by the committee). I believe that the best method would be to make the deck immediately above the overhead coal bunkers completely watertight throughout the full length of the ship. All openings from this deck such as boiler room uptakes, cargo hatches, etc., should be carried up to the top deck. The watertight deck above referred to should be made of sufficient strength to stand a water pressure equal to that exerted upon the bottom of the ship at normal draft. In case of serious injury, affecting four or even more compartments, the ship would settle until it floated upon this deck as a second inner bottom."

We note with satisfaction that at the twenty-first meeting of the Society of Naval Architects and Marine Engineers, held in this city during the present month, a distinguished naval architect, George W. Dickie, vice-president of the Society, presented a brief paper in which he gave the general particulars of a ship built according to these principles. The drawings represent a modern passenger steamer of about the size of the "Titanic." Protection against sinking is afforded by a double, cellular upper deck, five feet six inches in depth, the lower floor of which is located at about the normal water line, and the upper floor, throughout the middle portion of the ship, some five and a half feet above this. The lower floor throughout the length of the boiler spaces is parallel with the keel of the ship. Beyond the boiler spaces it slopes down to a junction with the stem forward and the stern aft, its form longitudinally being thus generally similar to that of the protective deck of a warship. Forward of the boiler spaces the accommodation between the two floors of this watertight deck is utilized to receive stores of all kinds. Aft of the boiler spaces, the accommodation is utilized for cold storage compartments. Over the boiler and engine rooms this space forms what Mr. Dickie calls the "sub-basement of the hotel part of the ship above." All ventilating ducts, salt and fresh water mains, and drainage pipes are arranged in this space; so that vertical piping only needs to be carried to the rooms above. This would obviate the great structural difficulties involved in carrying horizontal piping ducts through the passenger accommodations themselves; an improvement which Mr. Dickie justly considers to be "a very important feature of such a design."

The space between the floors of this upper deck would provide 9,730 tons of buoyancy, which, even if three of the large boiler compartments below were open to the sea, would still leave the upper floor of the deck materially above the water-line. If the side of the ship, as in the case of the "Titanic," were ripped open for a considerable portion of her length, below the lower floor of the upper deck, and the five large boiler compartments were filled, 14,020 tons would be added to the displacement. If the forward holds were flooded and it were necessary to flood the after holds in order to trim the ship, 3,400 tons of water would enter and the total amount within the ship below the cellular upper deck would be 21,000 tons, which would cause the ship to settle until the water was 6.36 feet above the upper floor of the upper deck. To render the ship safe against sinking under these conditions, it would, of course, be necessary to so build her that there should be no air "pores" or sidelights between the upper and shelter decks, through which water could enter. This difficulty could be overcome by building specially strong sidelights with the glass cast around a wire mesh as a protection against cracking.

Mr. Dickie, who surely is an authority, pronounces such a ship unsinkable, even under the extreme conditions of being flooded from stem to stern below this upper deck. Such an eventuality, however, is extremely remote. The passengers who stepped aboard this vessel, would do so with the perfect assurance that the calamity which overwhelmed the unfortunates on the "Titanic" would never overtake themselves.

It should be mentioned that Mr. Dickie's plan provides for the housing of the engineer and boiler-room forces within this double deck, through the center of which a continuous passageway would run, rendering possible all needful intercommunication, and obviating the necessity for stairway openings through the upper deck to the decks above.

The scheme as thus briefly outlined is practical. It does not involve inclusion within the ship of unused spaces; it solves the difficulty of piping and wiring, and it provides an absolutely safe ship. If such construction were rendered obligatory by law on all the larger passenger ships, it would work no hardship upon either the builder or the owner, and it would remove absolutely and forever the possibility of another "Titanic" disaster.

Evolution and Ascension

THE concept of evolution is very commonly associated with that of ascension, the passage from a "lower" to a "higher" type, as the saying is. A closer examination of this popular idea shows it to be lacking in scientific precision. Underlying it is esthetic judgment of what appears to our artistic sense as more noble, rather than a scientifically attained conclusion. Still, the presumption is that there is some measure of truth in an idea so widespread and of so many years standing. What, in accurate terms, is the characteristic trend of development by evolution?

There can be little doubt that general rules cannot be laid down. The course of evolution will depend upon circumstances. But insofar as general conditions of environment change but slowly, and may therefore as a first approximation be considered constant, there is probably a correspondingly constant trend in the course of evolution. Under constant conditions the tendency is, as a rule, for evolution to proceed from simpler to complex forms. We say, as a rule, for there are unquestionably exceptions to this, cases which may be described as degeneration, but which nevertheless represent increasing adaptation to existing conditions.

Now the geologist and palaeontologist are well acquainted with certain sudden breaks in the geological record, occasioned by some *comparatively* sudden or "catastrophic" change in the condition of the earth's crust—the submersion of a continent in the ocean, or the emergence of land from the sea, or more or less profound climatic changes. Here the constancy of conditions is broken, and forms of life which had become highly specialized, complex, particularly well adapted to the conditions that had long prevailed, are now least fitted to fall in with the new order of things. Thus it comes that a geological "unconformity" is usually accompanied by a sudden change in fossil flora and fauna, and that in this change the "highest" types are found to have suffered most.

Antivivisection Hysteria

AT the close of the year which marks the twenty-fifth anniversary of the founding of the Pasteur Institute, it is fitting to look back and with grateful appreciation to survey the incalculable benefits which have come to us through the labor of such men as Pasteur, Tyndall, and Lister. We cannot here attempt an exhaustive account of all the triumphs that have come to medicine and surgery through the discovery of the bacterial origin of infectious diseases, and through the aseptic methods and antitoxin serum therapy based upon this discovery. We must be satisfied to single out a few of the most significant facts.

Let figures tell their eloquent tale:

MORTALITY AMONG PERSONS AFFLICTED WITH SEVERAL DISEASES.

Disease.	Before Introduction of Serum Therapy and Asepsis.	After Introduction of Serum Therapy and Asepsis.
Rabies	About 16	Practically 0
Lockjaw	About 80	Practically 0
Diphtheria	About 30	About 8
Meningitis	About 80	About 20
Plague	5	0.4
Puerperal fever in hospitals	5 to 57	0.1
Compound fractures	67	Less than 1

Ex-President Taft in an address before the Medical Club of Philadelphia, on May 4th, 1911, said: "Of the volunteer regiments mobilized during the Spanish-American war, 90 per cent became infected with typhoid fever within eight weeks from the date of mobilization. To-day, two months after mobilization, with modern health regulation and the use of vaccination against typhoid, not one case of typhoid fever has appeared in the entire force, except that of one teamster, who was not vaccinated."

Regarding the ravages of yellow fever during the French Panama Canal enterprise, before the cause of the disease was understood, we quote from an article by Dr. Orenstein, as published in our issue of November 9th, 1912: "The family of a French chief engineer consisted of five; four died of yellow fever. Of the five members of the family of the superintendent of the railroad, three died of yellow fever. Of twenty-five Sisters of Charity who came to Ancon Hospital, twenty died of yellow fever."

Contrast with this the following figures, taken from the American period of work, when the mode of transmission of yellow fever by the Stegomyia mosquito was known and precautions were taken accordingly: "From July 1st, 1904, to June 1st, 1905, 77 cases of yellow fever originated on the Isthmus. In June, 1905, 62 cases; in July, 42; in August, 27; in September, 6; in October, 3; in November, 2; December (in Colon), 1. During 1906 there was only one case of yellow fever on the Isthmus, in Colon. Since then not a single case of yellow fever has occurred on the Isthmus, although a continuous influx of non-immunes is taking place."

We would like to extend this list of triumphs further, but space is lacking, and there is another matter on which we wish to touch. We will introduce it by a few further significant figures:

MORTALITY AMONG ANIMALS AFFLICTED.

Disease.	Before Introduction of New Methods.	After Introduction of New Methods.
Anthrax:		
Sheep, on certain French farms	10	1
Cattle, on certain French farms	5	1
Distemper in dogs (Karl Hopf's kennels)	50	2
Malignant jaundice of dogs (South Africa)	50–100	Practically 0*

*Among animals treated.

Other diseases of animals which have been successfully attacked by methods built upon Pasteur's work are rinderpest, pleuro-pneumonia of cattle, Texas cattle fever, swine erysipelas, glanders, etc.

There are, unfortunately, some ill-informed, and, we add without hesitation, ill-balanced people, who seek to oppose the wonderful progress here recorded because it has been gained through experimentation upon animals.

To the consideration of the more thoughtful among these we would commend the last quoted figures, which show that animals themselves have amply benefited from such experimentation. True, this argument will seem unnecessary to the unbiased reader who has perused the earlier paragraphs of our comments. But we are now speaking to the biased reader.

As for the hysterical and irresponsible antivivisectionist, we will attempt no missionary work on him (or her), but shall feel that our function is fulfilled when we have warned the other members of the community of the viciousness of the mental attitude and the methods resorted to by such misguided persons. Those who wish to inform themselves in detail on this point are referred to a pamphlet by Dr. W. W. Keen, "The Influence of Antivivisection on Character," published by the American Medical Association. From this, to illustrate our point, we will merely quote an anonymous letter received by Dr. Keen:

"Arch Fiend:

"I have read with horror your article in the *Ladies' Home Journal* on vivisection.

"I hope your mother, if she is living, will die in the most terrible torture, and if she is dead, that she will never know rest for, having given life to such a vile monster as you—is the nightly prayer of a dozen women who indite this."

This, written to a man who is following in the footsteps of Pasteur, doing the noble work of the medical profession.

Engineering

Novelty in Gunboat Construction.—Two gunboats, the "Monocacy" and the "Palos," of 190 tons displacement, have been built at the Mare Island Navy Yard for shipment in separate sections to China. Here the sections will be assembled at the works of the Shanghai Docks and Engineering Company. They are to carry a battery of two rapid-fire guns, and as part of the Asiatic fleet, they will cruise up and down the rivers of China.

Grand Trunk-Pacific Railway Nearing Completion.—The Grand Trunk-Pacific Railway, which will give a new continuous route from the Atlantic to the Pacific, through Canada, has been so far completed that there remains to be built only a gap of 220 miles, between Winnipeg and the Pacific Coast. On the mountain section over 600 miles of track have been completed, and the consulting engineer for the government states that as labor is abundant, the line will in all probability be finished by the first of June, 1914.

Risk of Death on Railroads.—A contemporary has estimated that since the average length of a railroad journey in this country is 34 miles, and a passenger may take 2,275,122 such journeys with only one chance of being killed, it would take him, at two trips per day, 3,792 years to run the full gamut of risk. That is to say, if the one fatal accident happened to him in the present year, it would have been necessary for him to start his railroad traveling, at two trips per day, in the year 1879 B. C. It must be borne in mind, however, that he might be killed on his very first trip.

George Washington as a Surveyor.—That George Washington was at one time engaged in surveying is well known; but it has remained for the modern engineer, working with the present instruments of precision, to show that in spite of the crude instruments of his day, Washington was a most careful and accurate surveyor. The attention which has recently been directed to this matter has called forth a widespread appreciation of the fact that he showed in this work of his youthful days many of those qualities which, in after life, served to make him one of the leading figures of his age.

The Blacksod Bay Atlantic Route.—Discussing the proposed short route across the Atlantic *via* Blacksod Bay, the *Shipping World* draws attention to the fact that passengers dislike very much the trouble and annoyance of any transshipment, and American and Canadian travelers are not likely to take kindly to a railway journey across Ireland, a steamer passage across the Channel, and another railway journey to their destination. Further, on the reverse journey, passengers will prefer to embark either at Liverpool or Southampton to being subjected to the inconvenience of going direct to Blacksod Bay by train and a coasting steamer. Such a service could not be a success without handling a large amount of cargo, and as Blacksod Bay is so far removed from the large industrial centers, this class of traffic is not likely to be attracted.

For the Comfort of the Seamen.—The Secretary of the Navy has approved the provision of a reception and reading room for the crew in the case of the U.S.S. "New York," now building at the Navy Yard, Brooklyn. This consists of a commodious compartment in a location very accessible to visitors. In this room is to be located the crew's library, and the room is further to be fitted with reading tables, writing desks, paper and magazine racks, chairs and transom. Adjacent to this room are to be lavatory facilities for the use of guests of the crew. This provision for a reception and reading room for the use of the crew and their guests is a new departure in warship design, and has been inaugurated by the Secretary of the Navy for increasing the comfort of the crew and adding to the attractiveness of the ship for the enlisted men and their visitors when in port.

Safe Building Laws.—Mr. Ernest Flagg, the architect, has done good service in his criticism before the Aldermanic Committee of this city, of the existing building code and his suggestions as to the framing of future laws. The present proposed revision of the law is an attempt to make its requirements conform to the present state of the building art. It includes standards of building under which we suffer an annual fire loss of $5 per capita, as compared with the loss of only 30 cents per capita per annum sustained in France. The better European methods specify that buildings and streets shall have sufficient light and air; that cellars shall be covered with incombustible material; that walls shall be thick enough to stand independently of bracing from floor beams. Our present law permits the separation of buildings by walls which are too thin to stand without bracing, and under them the erection of non-inflammable buildings is too expensive. Our building code should be framed purely on the merits of the case, and without reference to the commercial interests of competing firms.

Science

The Kite Station of the Deutsche Seewarte, at Gross-Borstel, near Hamburg, was almost completely destroyed by fire on August 16th.

Port Harcourt is likely to be conspicuous on maps of West Africa in the near future, though the place does not yet exist. The British principal secretary of state for the colonies has consented to have his name given to the proposed terminal, at the head of the Bonny estuary, of a trunk line of railway that will run northward from that point for some 400 miles across the east-central part of Nigeria, and connect at its northern end with the Lagos-Baro-Kano system. This line will traverse a fertile and populous district and tap important coal and tin mines.

The Royal Observatory of Belgium, at Uccle, near Brussels, has been divided into two distinct establishments; one devoted to astronomy, together with astrophysics, geodesy, gravity, and seismology; the other to meteorology, along with climatology, terrestrial magnetism, and atmospheric electricity. The former will be known as the Royal Observatory of Belgium, the latter as the Royal Meteorological Institute of Belgium. The effect of this new arrangement is to give the national meteorological service of Belgium an independent status, whereas it was formerly merely an appendage of an astronomical observatory.

Disappearance of Two Pacific Islands.—Press reports state that Falcon and Hope Islands of the Tonga or Friendly group, in the South Pacific, have sunk in the sea, carrying with them several hundred natives and a few white men. Both islands were volcanic. Falcon Island was first seen as a breaking reef from H. M. S. "Falcon," in 1865; in 1877 smoke was seen issuing from the sea at this place; and finally, in 1885, a full-grown island appeared, consisting of loose volcanic ashes. A considerable part of it was subsequently washed away by the action of the sea. We assume that the "Hope Island" of the newspaper report is Good Hope Island, or Niuafou, which has been the site of numerous volcanic outbreaks, entailing much loss of life and property. The Tonga Islands constitute a native kingdom under British protection.

Natural Root-grafting.—An article by A. Howard in the *Agricultural Journal of India* describes the attempts made at the Pusa Experimental Station to protect field crops from injury by the roots of neighboring trees, by digging a deep trench each year between the trees and the adjacent cultivated area. In the case of some trees this plan proved successful, but not in the case of others, such as the pipal, banyan, and teak. When the trenches were opened up it was found that the severed roots had become connected again. New roots had been formed at the cut extremity, they had grown across the trench, which was 24 to 30 inches wide, and united with the severed portion of the root by a process of natural grafting, followed by a rapid thickening of the connections, which attained a thickness of 0.8 to 1.1 inches in twelve months.

Evaporation During the 1912 Haze.—The henceforth historic "haze of 1912" appears to have registered itself unmistakably in the evaporation records of the great plains and the intermountain districts of our western States. This subject has been discussed in a memoir by L. J. Briggs and J. O. Belz, of the U. S. Bureau of Plant Industry, on the basis of measurements made at a number of evaporating tanks during the past five years. As compared with the "normal" for the whole period of observation, the average evaporation measured at fifteen stations during the four months following the eruption of Katmai was generally deficient, the average reduction amounting to about 10 per cent. This corresponds fairly well with the reduction in solar radiation observed by Abbot and Fowle and by Kimball during the same months.

The Composition of Cows' Milk may be materially modified by the effects of certain drugs which are in common use in medical treatment, such as sodium sulphate, magnesium sulphate, rhubarb, aloes, and arsenic, according to recent discoveries of O. Lanzoni, published in *La Clinica Veterinaria.* In the writer's experiments all possible precautions were taken to eliminate the influence of other factors affecting the composition of the milk, such as breed, age, time of milking, feeding, air, pathological and physiological conditions, etc. Two samples of milk were taken from each cow, one before and the other after the administration of the medicine. It was found that all these drugs produce considerable alterations in the chemical composition of the milk, which affect its chief nutritive constituents. The alteration may consist in the loss of all nutritive property, owing to the great decrease in the total solids, or may make the milk unsuitable for food, e. g., from an excess of casein rendering it indigestible. Such milk is not hygienic, and should not be sold except for special purposes, and under the name "medicinal milk."

Aeronautics

Another Parachute for Aeroplanes.—The question of parachutes for aeroplanes so as to allow of a safe descent continues to occupy the attention of inventors. Numerous experiments are being carried on in France, and it is now stated that a Berlin police lieutenant has invented a new parachute which differs from what has been heretofore presented, for the parachute surface is operated in connection with the wings of the aeroplane. On his scheme, a large surface of cloth is rolled up and attached to the wings, this being released by a lever so as to spread out and allow the flyer to descend slowly to the ground.

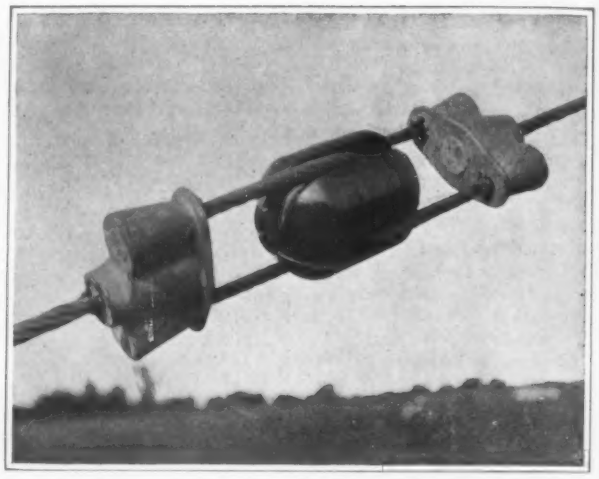
The Carnegie Museum to Have Rodgers' Transcontinental Aeroplane.—All that is left of the historic Wright biplane with which Calbraith P. Rodgers flew from the Atlantic to the Pacific two years ago, is to be presented to the Carnegie Museum at Pittsburgh by the late aviator's mother. The machine was badly damaged when Rodgers fell to his death in the Pacific Ocean a short time after completing his wonderful flight. Subsequently it was used by Andrew Drew until that aviator also was killed with it. The machine has been restored to its original condition and will no doubt be prized by the museum to which it has been presented. This Wright biplane is the only machine that has flown across the continent of North America. Both Rodgers' and Fowler's Wright machines have motors of but 30 horse-power, yet they flew across the continent in opposite directions at a time when the aeroplane had not been equipped with the 100 horse-power motor of to-day, which makes it much more stable, nor had it developed anywhere near the speed of which it has since shown itself to be capable. Robert W. Fowler, the second transcontinental flier, is at present engaged in making bi-weekly trips between Oakland and Oroville, Cal., for the purpose of locating broken wires for an electric power company. An electrician accompanies Fowler and makes repairs.

Testing the Gas-tightness of a Balloon.—The following method was used for testing the "gas-tightness" of the balloon fabric used in the balloon "Goodyear," which won the 1913 Gordon Bennett Cup. A definite area of the fabric was placed between the halves of a gas-tight drum and the drum-sections firmly clamped together, thus forming two chambers with a wall of fabric between. The bottom chamber was connected with a source of highly purified hydrogen, the upper chamber with a compressed air pumping line, and exhausting itself into a combustion train. The gas-tight drum was then immersed in a tank of water, maintained at a definite, unchanging temperature, and hydrogen was admitted to the lower chamber of the drum at a constant pressure equal to two inches of water. As the gas diffused upward through the fabric and into the top section of the drum, it was swept out by the air current and carried through a glass tube filled with platinized asbestos heated to redness. This material caused the oxygen of the excess air present to combine with the diffused hydrogen to form water. The water thus formed was absorbed in a sulphuric acid bulb and weighed. By determining the weight of water in a unit of time, and knowing the area of fabric under examination, as well as the gas pressure and temperature within the drum, it was possible to calculate exactly the number of cubic feet of hydrogen diffused per square yard in 24 hours at the temperature and pressure of the test.

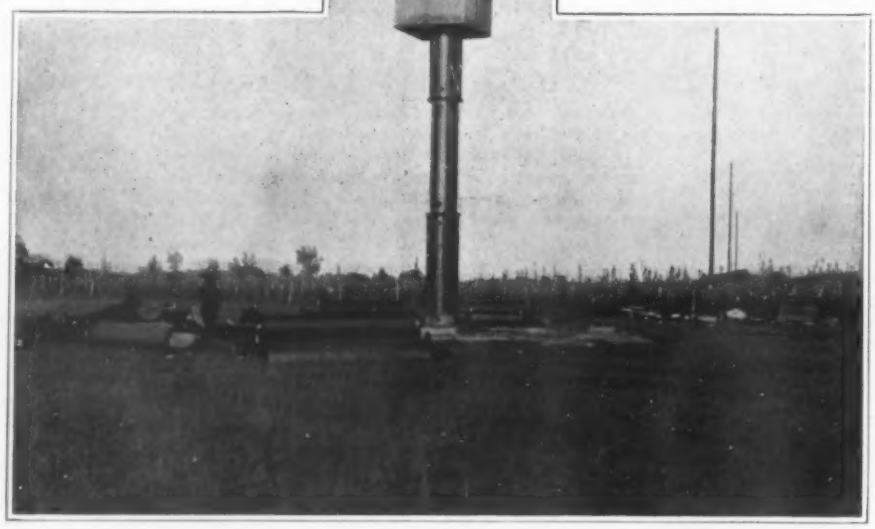
A Novel Experiment in an Aeroplane.—The vertical descent of an aeroplane is a performance which caused some surprise to those who witnessed it at the Buc grounds near Paris. Vicomte d' Autroche is an experienced military pilot and was engaged in the recent army maneuvers with the aeroplane corps. In the course of the maneuvers he took note of the fact that the aeroplane was called upon to spot a certain point on the ground, then pass above this place and let drop a bomb, but it became evident to him that it is very difficult to place the bomb while in rapid flight, and the object could be much better attained should the aeroplane remain motionless overhead, or else drop or settle down in direct vertical movement so as to approach nearer ground. He exercised in order to produce the settling down movement, and was soon able to do this; thereupon wishing to prove its possibility he approached Maurice Farman who was at first incredulous, for such a vertical descent in flat position had never been seen. But he was able to prove this at the Buc grounds not long ago. When at 3,000 feet height and in a wind of 60 feet a second, he appeared to stop completely in the air and the propeller turned very slowly. Then the aeroplane descended to the ground in the vertical line, but all the while keeping the usual flat position without overturning. This he repeated several times, and even with a passenger on board.

The pilot begins at any height placing himself against the wind, stops his motor and allows the aeroplane to descend. When 200 feet from the ground he starts the motor and alights as usual. He used a Farman biplane,

How the steel guy ropes of the great aerial masts at Belmar, N. J., are anchored in concrete.



The guy ropes are broken up into lengths to eliminate vibration as a whole. The method of joining is here shown.



The masts at the great Belmar wireless station consist of steel tubular sections.

The Great World Wireless Circuit

By J. F. Springer

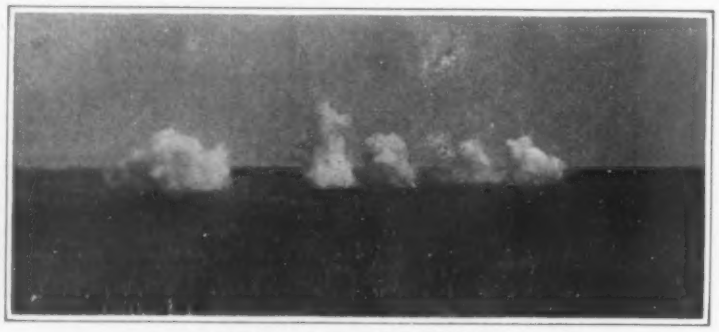
THE Marconi Company is now engaged in the construction of seven or eight great long distance wireless stations. These will form links in a world telegraphic circuit. One or two intervals where land is to be traversed will be covered by means of ordinary methods. The remaining intervals where enormous bodies of water lie between stations will have long distance wireless transmission. The stations now in contemplation or under actual construction are located in New Jersey, Wales, Egypt, India, Japan, Hawaiian Islands, and California.

The system of transmission is that known as the *directional*. That is to say, the aerials are arranged to extend along the line of transmission. For example, at Belmar, N. J., two straight-line aerials of silicon bronze, each a mile long, will be arranged in parallel straight lines *directed toward* the transmission portion of the Welsh station with which communication is to be established. More precisely, these aerials will lie on a great circle of the earth passing through the two widely separated points. Wireless impulses emanating from Wales will find along this circle the shortest path to their destination. Further, it would seem as if the similarly arranged aerials in Wales would send their strongest impulse along the line of their direction, and that the aerials at Belmar would accordingly be finely situated to catch the almost exhausted "waves" as they complete their great journey.

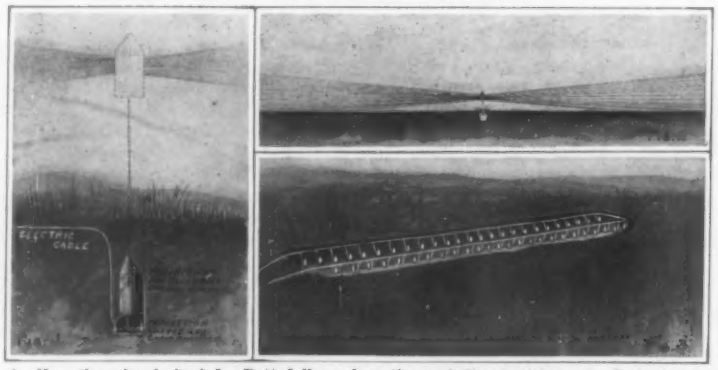
Belmar will be the receiving portion of the New Jersey station. The transmission aerials will be located thirty miles away at New Brunswick. However, the *hand* of the transmitting operator will be at Belmar. Ordinary telegraphic methods will be employed to carry the message to New Brunswick. Here, automatic wireless keys will transform the Morse message into a wireless one which will strike out across the Atlantic to the Welsh coast. The dozen of aerials at New Brunswick will be directed also along the shortest path to their objective point. The New Brunswick transmission apparatus is located so far away from the receiving aerials at Belmar in order to reduce by distance their interference with the weak impulses coming in from the Atlantic onto those aerials. Further, the impulses going out from New Brunswick will presumably be strongest along the line of their aerials and weakest along a line at right angles to it. Now Belmar actually lies on a perpendicular to the great circle passing through New Brunswick and the Welsh station. We may see then that these locations were not selected at random, but with a perfectly well-defined object in view. By taking a map of New Jersey and laying off a line from New Brunswick in such a way as to make with the meridian an angle of 50 degrees east of north, and another running from New Brunswick to Belmar, the two lines will be found to be perpendicular to each other; the former lines extending in the direction of the Welsh station.

While the aerials to be held in position are very slight in themselves, still the fact that they have to be maintained under tension at a very considerable height imposes serious construction problems. The elevation at Belmar will be about 400 feet above the ground. The six steel masts or towers which will support the little wires will consist of tubular sections, each ten feet high.

(Concluded on page 498.)



A battery of grenades exploding.



1. How the mine is buried. Dotted lines show the exploding position. 2. Trajectories of bullets after explosion. 3. A battery of grenades.

How the Aasen grenades are used in warfare.

Fighting With Dynamite and Electricity

By Dr. Alfred Gradenwitz

A GLANCE at the history of strategy reveals a tendency noticeable in nearly all branches of human activity, viz.: a gradual superseding of the individual by collective labor organized and controlled by a few superior minds. Individual strength and valor, once the most important factor in warfare, has been reduced to a secondary *rôle*. This change became especially conspicuous with the introduction of gunpowder and continued apace during the nineteenth century with the rapid strides made by engineering.

Like industry, warfare is becoming more and more mechanical. Soldiers are now hardly more than tools in the hands of their captains. The issue of a battle depends almost entirely on numbers and positions. Personal bravery is not of prime importance. In place of it we have something like collective valor, a *morale* which may to some extent determine victory or defeat.

One of the latest stages in this development is the attempt to eliminate the personal element, the soldier, entirely and to substitute for him a machine or automaton. Something of the sort has actually been attempted by a Norwegian engineer, Mr. N. W. Aasen, whose "mine grenades" work practically without the help of soldiers, spreading death and destruction everywhere. His contrivance is illustrated in the accompanying diagrams, Fig. 1 showing the grenade in position in the field, and Fig. 2 at the moment of explosion, representing the spreading of the projectiles. Fig. 3 shows a double shell barricade 1,200 yards long and 100 yards wide, made up of 50 mine grenades joined up in two sets, and which on exploding, sweep an area of 108,000 square yards.

Each grenade, inclusive of its accessories, weighs about 9 pounds, and contains 400 projectiles and about 12 ounces of an extremely powerful explosive. The grenade consists of an iron cylinder with a conical point which contains in its interior the projectiles and explosive charge as well as the mechanism causing the grenade to rise from the ground and eventually to explode. This mechanism can be set working only by the action of an electric current supplied to the grenade through a flexible cable.

At the bottom of the cylinder there is a small powder charge which is ignited by the electric current and which projects the shell body vertically through the superincumbent earth layers. The fuse which ignites the shell body is connected with a chain, the opposite end of which is fixed to the cylinder remaining in the ground. Explosion thus occurs at the very moment that the chain is tightened.

The grenade and cable are buried in the ground, so as to be entirely invisible to

(Concluded on page 498.)

Skin Defects in Invisible Light

A Method That May Have a Wide Application in Medicine

By G. Michaud and F. Tristan, Costa Rica State College

SKIN defects are more numerous and conspicuous on large photographs made on ordinary fast plates than on the original. On the other hand, photographers know that portraits made with a yellow screen on orthochromatic plates show skin defects about as they are, and do not need as much retouching as portraits made without a screen or ordinary plates.

Such facts seem to show that the shorter the wave-length of light the greater are the differences in the reflecting power of distinct elements of the skin. To ascertain how far this rule holds good beyond the limits of the visible spectrum the writers made, in two different regions of the ultra-violet spectrum, two large photographs of the head of a man 52 years old. For comparison purposes a third photograph was made in visible light and another in the invisible infra-red light of the opposite end of the spectrum.

Figs. 1 to 4 show the results of the experiment. The accompanying diagram (Fig. 5) gives, in Angström units, the exact wave length of light used for each photograph and also the nature of the filter used to select such wave lengths out of direct sunlight.

In the invisible infra-red (Fig. 4) skin defects are conspicuous by their absence. Every element of the skin reflects light, and reflects about as much of it as white marble does. In fact, if it were not for the black mustache and eyebrows, the photograph might be mistaken for the reproduction of a statuary marble head.

On Fig. 3, made in visible light, we find the usual and well known dark patches and spot effects, the *bête noire* of the amateur portraitist who has not mastered the art of retouching.

Doubts might well be entertained as to the practicability of retouching at all if photographs were always the exclusive work of the wave lengths 3,700 — 4,300 (Fig. 2), for there is hardly one square inch of the face which is not covered with a curious network of dark or bright dots or lines forming different figures in different regions. The general appearance of the photograph is that of an interesting hospital case.

Considerable difficulty was experienced in getting a fair degree of definition with the uncorrected quartz lens used in the making of Fig. 1. However, owing to the very limited extent of the spectrum admitted through the silver film, and also to the small angle needed, neither anachromatism nor astigmatism were as troublesome as spherical aberration. This was partially overcome by a periscopic spectacle quartz lens, the convexity of which faced the object. Absorption of ultra-violet light by the white skin in the neighborhood of 3,200 A. U. is about what it is for the skin of a negro in visible sunlight and black spots are, *de ipso facto*, less conspicuous on the darkened field. Yet they are much more noticeable on Fig. 1 than on ordinary photographs. Correction of the quartz lens by means of a suitable fluorine lens would probably bring them out more sharply.

The exaggeration and multiplication of skin defects on photographs made in ultra-violet light is not surprising if it be considered that photomicrography with Zeiss' Uviol glass filter has revealed numberless hitherto unsuspected differences in the absorbing powers of animal and plant tissues. Such differences seem to be the rule not merely for proteids, but for nitrogenous compounds in general; if a number of different alkaloids are photographed through Fouçault's silver film, over one half of them appear as black, although all of them may be snow white, not only for the eye, but also on a photograph made in visible light.

Fig. 1.—Made in ultra-violet light: 3150 — 3250 Angström units.

Fig. 2.—Made in ultra-violet light: 3700 — 4300 Angström units.

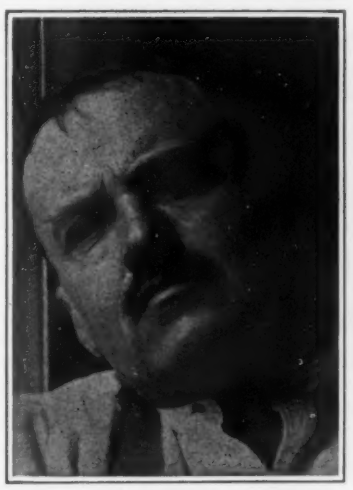


Fig. 3.—Made in visible light: 4700 — 5200 Angström units.

Fig. 4.—Made in infra-red light: 7300 — 7800 Angström units.

Cellulose (see the man's shirt, Fig. 1), starch, sugar, always remain white in such circumstances.

What are the anatomical differences between the skin patches which absorb and those which reflect ultra-violet light, histologists will one day tell us. Meanwhile ladies who wish to improve their looks, when at home, will do wisely to proscribe blue and violet wall papers and lamp shades and to favor, whenever practicable, illumination of a deep ruby color.

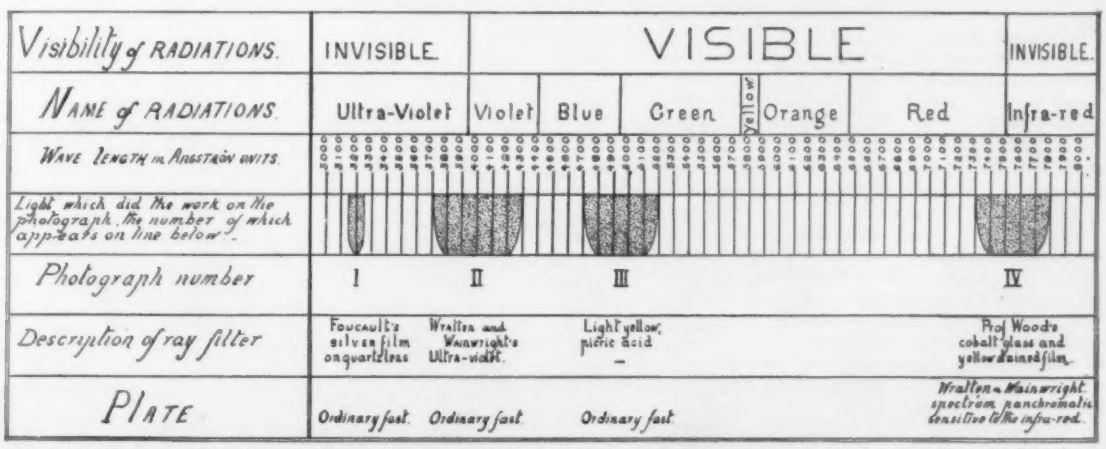


Fig. 5.—Diagram giving in Angström units the exact wave length of light used for each photograph and also the nature of the filter used to select such wave lengths out of direct sunlight.

Radium in Agriculture

ACCORDING to recent experiments in Europe it appears that radium is instrumental in preventing diseases of plants, whence is likely to arise a new application of this interesting element in agriculture. For several years, workers in agronomic science have been experimenting upon the effect of radium upon vegetation by mixing radio-active substances with the usual fertilizers. The numerous results obtained in this work show that most plants, either grain or flower, are remarkably stimulated and give a better yield both in size and quality, this being often seen in the fine and healthy color of the green plants or leaves. Under these conditions it is not surprising that the same plants are in better condition to resist attacks from various sources of disease such as cause so much damage to crops, especially diseases known as cryptogamic, which arise from spores or mold. It seems that radium is to act as a preventive for such diseases as wheat rust, rotting of potatoes, grapevine mildew and many others which cause such detriment to agriculture. Such a result is only to be expected from what we know as to vital phenomena in general, and among others as concerns the human body, for all influences that tend to reduce the vitality of the system are likely to leave it a prey to harmful outside influences and infections. Such results in the application of radium in agriculture are likely to be far-reaching.

A New Study of Anabiosis

THE state in which all vital functions of an organism are suspended without actual death, known as anabiosis, has been recognized for two centuries past, at least as concerns the lower orders of life, and such specimens can be dried and then recalled to life even after a considerable time by the sole action of moisture. A Russian scientist, Bachmetief, takes up the question as regards higher animals. He observes the organism of insects at decreasing temperatures down to 10 deg. below zero Cent. at which point death ensues. He thought at first that death was due to congelation of the liquids of the animal, but afterward saw that these congealed at —5 degrees and all the vital functions then became impossible. At temperatures intermediate between this and the death-producing point there occurs a strange state of anabiosis where the organism appears between life and death. In many cases he could bring the specimens back to life even after a long time, by gradually raising the temperature. He compares this state of latent life to a clock whose pendulum is stopped, but whose mechanism can be put in movement by a slight impulse given to the pendulum. M. Bachmetief extended his researches to small mammifers such as white mice and bats, and using artificial respiration, these animals can be brought to a state of lethargy at low temperatures such as zero Cent. or below. He now intends to experiment upon rabbits, monkeys and even human beings.

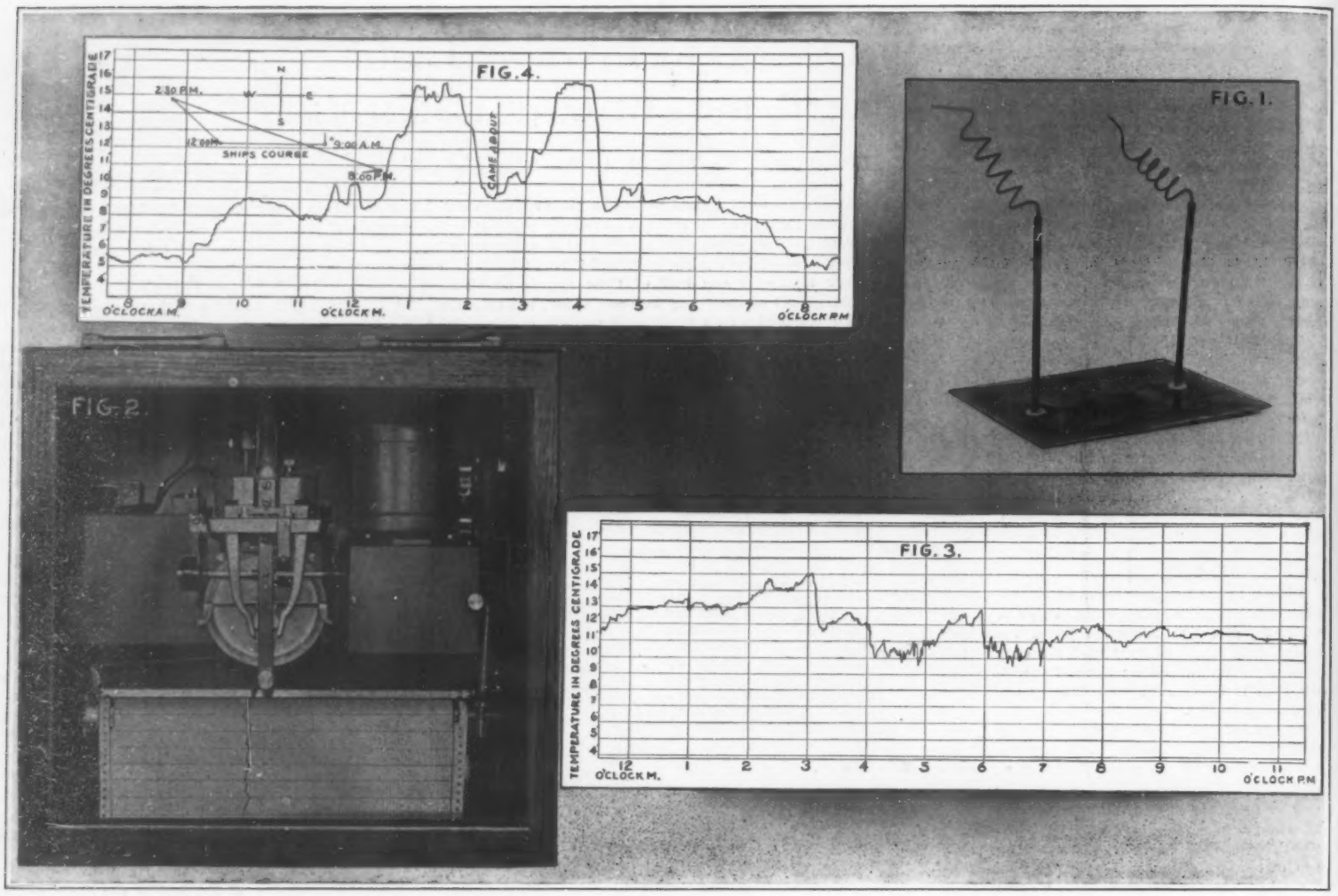


Fig. 1.—Surface electrical resistance thermometer. This consisted of a flat coil of silk-covered nickel wire inclosed between copper sheets and insulated by thin layers of mica. The resistance of the nickel coil was about 100 ohms. (Loaned by U. S. Hydrographic Office.) Fig. 2.—This Leeds & Northrup recorder was used with the resistance thermometers during the entire period of experimentation. A change of 1 deg. Cent. corresponded to a movement of the pen of 18 millimeters on the record sheet. The displacement of the paper was about 60 millimeters per hour. (Loaned by U. S. Hydrographic Office.) Fig. 3.—Temperature record showing the great and sudden changes in the sea water temperature when no ice is in sight. This illustrates how futile it would be to rely upon temperature records to foretell the proximity of icebergs. Fig. 4.—Chart shows how water temperature rose when ship left vicinity of iceberg at 9 o'clock A. M., and how temperature fell on approaching the same berg again at about 8 o'clock P. M.

The Autograph of an Iceberg

The Thermometer Not a Danger Signal That Warns the Mariner of Nearby Ice

By L. E. Browne

THE Bureau of Standards has completed initial experiments in solving the hazardous iceberg element encountered in navigating the North Atlantic Ocean during certain seasons of the year. Professors C. W. Waidner, H. C. Dickinson, and J. J. Crowe made observations of sea water temperature near icebergs and in the open sea with apparatus installed on the United States cruisers "Chester" and "Birmingham" with a view to determining the possibility of detecting the proximity of icebergs from temperature records.

The apparatus consisted of an electrical resistance thermometer with 50-foot leads and another with 150-foot leads of the Callender compensated type with four flexible, silk-covered coils of nickel wire of 100 ohms resistance. There was a surface electrical resistance thermometer made of a flat coil of silk-covered nickel wire inclosed between sheets of copper and insulated by thin sheets of mica. Also there were several mercurial thermometers of the Negretti and Zambra type loaned by the Bureau of Fisheries for deep-sea use.

A recorder was mounted in the torpedo room. This was so carefully balanced that the records were not influenced by the rolling and pitching of the ship. Continuous records were obtained from June 4th to July 10th. The surface thermometer was mounted with its flat side against the inner surface of the ship's ⅜-inch plates about six feet below the water line and the whole covered with a thick layer of cotton to eliminate the effect of the warmth of the torpedo room.

For the purpose of determining whether echoes could be detected from icebergs under water the ship's bell was lowered into the water and struck. Observers stationed at the submarine signaling receivers heard several faint echoes. The ship was at a distance of from one to two miles during the tests. If there had been time to improve the instruments a solution might have been found, founded on the echo theory. The commission has recommended that it be still further investigated.

It was found that the effect of cannon fire on icebergs was small. The use of searchlights in locating bergs was determined as practically futile. Lookouts stationed on deck invariably saw the bergs before men with glasses or in the tops. Water melted from large chunks of ice taken aboard the "Chester" from a berg showed that berg ice has great quantities of inclosed air, which probably accounts for the berg's whitish appearance. The density of this water was the same as that of distilled water. Air temperature observations showed that the iceberg has very little influence on the temperature of the surrounding air.

Temperature records showed that the variation in the warmth of water many miles from a berg is often as great as that in the vicinity of an iceberg. The commission reports that it will probably be impossible to establish set rules for detecting icebergs by means of temperature observations.

The Bureau of Standards party formed the conclusion that the "characteristic iceberg" effect upon the surrounding water as described by Prof. Barnes was not true. "Our records show an opposite effect to that noted by Prof. Barnes," stated the official records of the trip. Prof. Barnes' theory is that there is uniformity in the rise of temperature of water as the berg is approached and then a sudden drop. The party noted a gradual drop in temperature as the berg was approached from a distance of several miles. The official report of the Bureau party which has been sent to navigators throughout the world is in part given in the conclusions below:

"If the iceberg is constantly drifting into new waters its cooling effect on the ocean would be extremely small from the consideration of the fact that it would require the melting of about a million tons of ice to cool one square mile of ocean to a depth of 25 feet by 1 deg. Cent. The possibility of extensive cooling action would require that the berg and surrounding water drift together for considerable distance, and that the motion be slow. This is probably true under some conditions, but by no means always. Conditions such as these render it doubtful if any appreciable effect could be distinguished with any degree of certainty at a greater distance than a mile. To account for his theory, Prof. Barnes assumes that in regions of the ocean at some distance from the berg the surface layer, heated by solar radiation, is mixed with the cold water below the 'normal vertical circulation,' while near the berg there is a current set up toward the berg due to the combined effects of the melting and cooling action. Barnes assumes that this current interferes with the circulation so that the warm water remains on top. It is difficult to understand how a sufficiently strong current could be set up by the melting of the berg to interfere with the normal circulation. That there is no very strong current toward the berg is proven by the fact that on breaking off, large and small chunks of ice drift away from the berg.

"The records of sea water temperature show that its variations in parts of the ocean far removed from icebergs are often as great and sudden as in the neighborhood of icebergs.

"For the majority of the courses of the ship in the vicinity of icebergs there was a fall up to three deg. Cent. in a distance of four or five miles on approaching the berg. So far as the records go, it does not at this time seem possible to draw positive conclusions as to the absence or proximity of ice from the temperature observations of sea water. This is not a condemnation of the use of recorders on board ships. They will identify characteristic ocean currents and will announce the approach to shoal water."

While these tests, improved by the terrible "Titanic" disaster, are of the greatest interest to navigators, all of whom will be furnished with the results, the Bureau of Standards party feels that there should be even more exhaustive tests of the method before it is either accepted or discarded.

The World's Greatest Life-Saving Station

Twenty-fifth Anniversary of the Pasteur Institute

Preparing an antitoxin at the Pasteur Institute.

HAD we been summing up, in the last issue of the year 1888, the most significant events of the scientific year then drawing to a close, would we have had the wisdom to give to the founding of the Pasteur Institute that prominent place in our retrospect, which a subsequent twenty-five years' history has so brilliantly accorded to it? This is the last issue of the year 1913, and we can now look back, not merely to the founding of the Institute, but to a stretch of twenty-five years of a most fruitful activity. Anyone who should, in 1888, have prophesied the successes which have actually been attained, would probably have been derided as a dreamer. We have had occasion on another page of this issue to quote figures that eloquently proclaim the victories gained. But it must not be supposed that the list there given is complete or represents all that has been done. Even where no actual cures have been found, in many cases the knowledge gained through such studies as Pasteur initiated, has enabled us to greatly ameliorate conditions and reduce death rates. This applies for example to that scourge of humanity, pulmonary tuberculosis. The death rate from this has of recent years been cut in half in some localities. Another disease for which no certain cure has as yet been found is sleeping sickness. Yet the total annual death rate from this cause on the Uganda shores of the Victoria Nyanza has fallen from 8,000 to 500 as the result of preventive measures based on a knowledge of the mode of dissemination of the disease by the tsetse fly. While the Pasteur Institute was not directly active in the work on this disease, we may look upon Pasteur as the father of bacteriology and serum therapy, and to him, as such, homage is due for his indirect share in all the victories recorded in these fields.

Louis Pasteur was born in 1822, at Dôle, in the Jura district of France. He was the son of a tanner, who also had served in the French army, and had received from Napoleon himself the Cross of the Legion of Honor. When he was 16 he went as a pupil teacher to the college of Besançon, to learn and teach mathematics. When he was 20 he went to Paris to study chemistry under Dumas and Biot at the Ecole Normale, the great training college of young men of science.

In 1848, working at the influences of crystalline substances on a ray of polarized light, he solved the problem of the different forms of tartaric acid. By this work on tartaric acid, which is a grape acid, he was led to his discoveries in the kingdom of the ferments. He was at work for more than a quarter of a century on the subject of fermentation; and he introduced great improvements into the methods of brewing, distilling, vinegar making, and wine making. It was well said by Huxley of this part of Pasteur's work, that he had saved France more than enough to pay the indemnity of the Franco-German war.

In 1865, without leaving off his work on ferments, Pasteur took up the study of the silkworm disease, which was wrecking the silk trade of France. After five years of laborious work on this subject, he discovered and proved the infectious character of the disease, and was able to restore prosperity to the silk trade.

Next he took up the study of the infective diseases of animals higher than silkworms: anthrax in sheep and cattle, fowl cholera, and swine erysipelas. His protective treatment against anthrax has by this time safeguarded millions of sheep and cattle against that disease. Reports from France and from Hungary show a reduction of the death rate on many farms from 10 per cent to 1 per cent among sheep, and from 5 per cent to less than 1 per cent among cattle.

Filtering serum in one of the storerooms of the Pasteur Institute.

During these years (1870-1880), and for some years before 1870, Pasteur, Lister, Tyndall, and other men of science in diverse countries, were founding and proving the antiseptic and aseptic method of surgery. By this discovery, they enabled all surgeons to save lives and limbs which, before the days of Pasteur and Lister, would have been lost. It is impossible to set a limit to the number of people who owe their lives to the work done by Pasteur and Lister.

The preventive treatment against rabies was the last of Pasteur's great discoveries. But, long before he died, his work was extended all over the world. Between 1880 and 1890 men of science working on Pasteur's lines had discovered the germs of tubercle, cholera, diphtheria, typhoid fever, lockjaw, and Malta fever. In 1893 came the discovery of diphtheria antitoxin, and of the protective treatment against cholera: in 1894-5, the discovery of the germs of plague, and of the tsetse fly disease; in 1896-7, the protective treatments against typhoid fever and plague; in 1898-1900, the final proofs that malaria and yellow fever are conveyed by special kinds of mosquitoes; in 1903-5, Bruce's work on sleeping sickness and Malta fever; in 1907-10, Flexner's work on epidemic meningitis and on epidemic infantile paralysis, and Ehrlich's work on the treatment of a widespread contagious disease. These and other life-saving discoveries have been given to the world, as it were, by the hands of Pasteur. Nor is it only men, women, and children who owe their lives and their health to him. The diseases of animals, no less than the diseases of man, are nowadays better understood, better recognized, better treated or prevented, thanks to Pasteur. Anthrax, rinderpest, pleuro-pneumonia in cattle, Texas cattle fever, swine erysipelas, glanders, distemper, malignant jaundice in dogs, tubercle in cattle, lockjaw in horses—the very names of these great scourging diseases of the animal world recall to-day the influence of Pasteur's work.

He died in 1895. To-day, whether we look at surgery, or at medicine, or at public health and sanitation, or at veterinary surgery—over the whole face of the earth, whichever way we look, his

A rabbit which has been selected for inoculation.

Injecting a horse in order to prepare anti-diphtheria serum.

work lives, and his methods are extended, for the saving of human and animal life and health.

As already stated, the cure for rabies was Pasteur's last discovery. When we remember the horrible nature of the disease, we may well imagine with what enthusiasm the announcement of the new cure was received. The French Academy of Sciences made an international appeal, in response to which two and a half million francs were obtained by public subscription, and in November, 1888, President Carnot dedicated the institute that bears Pasteur's name.

It is interesting to recall some of the incidents in Pasteur's researches on rabies. He was experimenting with rabbits, and observed that the spinal cord of subjects dead of rabies became unocuous after drying for two weeks. He inoculated dogs first with this two-week old vaccine, then with virus 12, 10, etc., days old, and finally with perfectly fresh virus, when it developed that dogs submitted to this treatment had become immune to infection. After making his communication to the Academy of Medicine Pasteur was stormed with requests to extend his treatment to man. His conservative attitude toward this matter is shown by his reply to a letter from the Emperor of Brazil. Pasteur says: "Even after numberless experiments on the action of anti-rabies serum with dogs, it seems to me that my hand will tremble when the time comes to experiment on man." But circumstances forced him to make the trial sooner than he had anticipated. A young Alsacian boy was brought to him, with fourteen bites from a mad dog. Only after having obtained the consent of the dean of the Faculty of Medicine and of Prof. Grancher did Pasteur take the momentous step. On July the 6th, 1885, the first vaccination against rabies was performed, and the boy's life was saved. Shortly after the second case was treated, a young shepherd of the name of Jupille, who from that date remained in faithful service to Pasteur. Jupille has become a historical figure, as is only fitting, for he received his wounds in protecting a group of children from a mad dog, whom he strangled. This episode furnished the subject for an appropriate statue now in the grounds of the Pasteur Institute. The young shepherd is shown struggling with the mad dog. Strangely enough, Jupille in later years has been caretaker at the Institute, and a picture published in a French periodical shows him as the "guardian of his own statue."

Inoculating a man with anti-rabies serum.

We are fortunate enough to possess in this country an institution that nobly represents for America what the Pasteur Institute is to France: The Rockefeller Institute, endowed with almost unlimited wealth, and giving opportunity to men of the very highest talent to do their share in a great work.

It is most regrettable that this noble institution has been maligned by certain utterly incompetent and unsound persons. Among those who know the facts, such libels can work no harm. But not every one knows of the splendid work accomplished, and we cannot err in again praising the efforts made and their success. The Rockefeller Institute gave birth to the anti-meningitis serum that reduced the mortality of this dread disease from 80 per cent to 20. The work on the transfusion of blood there carried out has been the saving of scores of lives. At this institute a method of criss-crossing arteries and veins (which almost always run alongside each other) has been discovered, by which impending gangrene has been prevented.

In one of the leaflets published in opposition to the Institute, the writer expresses horror at the proposition of the Institute "to build a hospital where experiments may be conducted on human beings." It may be of interest to this author and also to others to know that this hospital was opened in October, 1910, and that the public have thronged to it in such numbers that hundreds of disappointed applicants had to be refused admission.

The famous monkey room of Prof. Metchnikoff.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Night Rainbow

To the Editor of the SCIENTIFIC AMERICAN:

While a night rainbow may be a very common thing in some parts of the world it is almost unheard of in South Dakota. Therefore, the one that was witnessed by the people of Platte and vicinity on the night of November 6th, 1913, was viewed with much wonder.

At eight o'clock in the evening a thunderstorm came up and at nine-thirty the sky rapidly cleared and the moon, which was a day past first quarter, shone directly on the clouds and falling rain as they moved away to the northeast.

The result was a rainbow equal in brilliance to the secondary day bow, but being at night was very noticeable.

This bow completely arched the sky, showing equal brilliance at all points. The colors were marked as distinctly as those of the beautiful spectrum with which we are all familiar.

The writer has talked with a number of people regarding this peculiar phenomenon and has not found anybody that had ever before seen its like.

Platte, S. Dak. GUY NASH.

[The foregoing observation of a lunar rainbow is chiefly interesting on account of the distinctness with which the spectral colors were seen. Owing to comparatively feeble illumination such bows do not generally produce any very sharp impression of color upon the retina, although actually the same dispersion of light occurs as in a daytime bow.

However, the impression prevailing even among meteorologists that lunar rainbows are nearly *always* white or but indistinctly colored is not borne out by an examination of the files of such journals as the *Meteorologische Zeitschrift*, *Symons's Meteorological Magazine*, etc., in which many descriptions of these nocturnal phenomena have been published. In fact, it happens rather more often than not that a lunar rainbow brilliant and striking enough to be thought worth reporting to the scientific journals is described as showing its colors distinctly.

It seems unnecessary to discuss Mr. Nash's observation further, inasmuch as we commented at length on a similar observation a couple of years ago. See SCIENTIFIC AMERICAN, May 6th, 1911, p. 447.—EDITOR.]

The Double Report of Projectiles

To the Editor of the SCIENTIFIC AMERICAN:

I was somewhat surprised at a note in your correspondence column in the issue for the 13th inst., which stated that there is some doubt as to the cracking sound, or sound of a double report, noticeable when a high-velocity projectile passes. This sound, which may seem louder than the report of the piece if the latter is fired from a distance, is only noted in projectiles of a greater velocity than 1,100 foot-seconds, which is about that of sound waves, and is caused by the bullet passing through the atmosphere. As its velocity is equal to or greater than that of sound, its arrival at a point opposite the hearer precedes that of the sound waves it set up at an earlier stage of its flight, and the sharp crack the bullet makes is caused at that part of its flight opposite to or nearest the hearer. As it recedes from the hearer, the sound waves apparently follow it away from the hearer, and do not come strongly back to him, and they are drowned out by the relatively more intense sound made by the projectile at the instant it passed him. If, however, the person noting this phenomenon is at some distance from the line of flight of the projectile, he hears the sound made by the projectile over a considerable part of its course blending with and following the sharp report it makes as it passes him, and if his position is sufficiently distant, the report of the projectile so blends with this whizzing or roaring sound as to be nearly lost in it. In the case of a small bullet, the sound much resembles the tearing sound made in tearing stiff, strong cloth, and in case of a large projectile it sounds much like a train in a tunnel or covered bridge. It follows that unless one is very distant from its course, he cannot hear such a swift-moving projectile until it has passed him; therefore, the bullet he hears can never strike him. A small bullet is not often heard after being fired by one standing near the firer, as the rifle report drowns the sound it makes for a long enough time to permit it to travel beyond hearing distance, but this is not true of cannon projectiles, which make a much louder sound, audible farther away. Modern high-velocity bullets do not "whistle" until they take up a ricochet flight, after grazing some object, unless they tumble, or otherwise fail to fly true. Under the latter conditions they emit the weirdest sounds imaginable, in great variety. This is due to their low velocity, often distorted shape, and erratic flight. In conclusion I note your correspondent's use of the term "steel-jacketed bullet." I have been familiar with modern small arms and ammunition for over twelve years, and have used ammunition dating as far back as 1896, and have never seen a steel-jacketed bullet. To use steel jackets would damage and soon spoil the lands of the barrel, owing to the hardness of the steel, and thus ruin the rifling. The material used is a cupro-nickel alloy, combining the necessary toughness with a texture sufficiently soft to preserve the rifling.

G. W. EDGERLY, *First Lieutenant Fifth Infantry.*
Plattsburg Barracks, N. Y.

Tidings from the Poles

THE attainment of the terrestrial poles has, contrary to general expectation, increased rather than diminished popular interest in the subsequent activities of circumpolar explorers. One token of the growing popularity of the subject is the large amount of space now devoted to it in the daily press. Latterly it has become an established custom for the leader of a polar expedition to contract with a great newspaper or group of newspapers for a series of detailed reports of his achievements, to be rendered by cable as often as circumstances permit. Thus the *New York Times* is the accredited mouthpiece of the Canadian Arctic Expedition, and the *New York Tribune* of the Crocker Land Expedition. So well is the task of reporting these polar undertakings now carried out, in comparison with the methods of a few years ago, that one is encouraged to hope for still further improvement in the near future.

For example, it does not seem too much to expect of the great press associations that they should have all news of polar explorations and discoveries edited by an expert geographer before sending it broadcast over the land. A conspicuous illustration of what is likely to happen in the absence of this precaution was afforded last October when the discovery of Nicholas II Land was heralded throughout the country as the discovery of an Arctic "continent," or "land as large as Greenland." The first dispatch from St. Michael, which stated the latitude and longitude in which this discovery was made, should have enabled the veriest tyro in Arctic geography to recognize as impossible the existence of a large land mass in the reported location; yet not only did the newspapers all over the United States publish whole columns dilating upon the attainment, by the Russian expedition, of the identical "continent" which the expeditions under Stefánsson and MacMillan are now seeking, but they cited in support of these vagaries some presumably much-distorted interviews with polar authorities of the highest rank—who can hardly yet have ceased to blush over the fatuous remarks attributed to them on that occasion. Another curiosity in polar news was the Associated Press dispatch of August 27th, 1913, announcing that Dr. Douglas Mawson and five companions had been rescued in a starving condition from Macquarie Island. It would be extremely interesting to ascertain whether a single newspaper which published this "story" commented editorially upon its manifest inaccuracy, or has since taken the trouble to publish a correction. Mawson was, of course, not at Macquarie Island, where he established a radiotelegraphic station on his way to the Antarctic, but in Adélie Land, on the Antarctic continent, and could not by any chance have been reached by a relief expedition at that season of the year.

Again, may we not reasonably ask for a little more care in the spelling of personal names? Even if mistakes in spelling are inevitably made in telegraphing—and we believe they might easily be reduced to a minimum if verbal accuracy were not so lightly regarded by the newspapers—surely a well-informed editor could restore most of the bungled names to their correct orthography before they appeared in print.

There is a certain Australasian member of the Canadian Arctic Expedition whose name has, to our knowledge, appeared in eight different forms in press dispatches of the past few months, and some of the spellings are so erroneous as to disguise effectually this individual's identity. One need not be a purist to demand something better; for there are doubtless some newspaper readers who would like to look up the history and scientific standing of Stefánsson's ethnologist—an indispensable preliminary to which process is to ascertain the gentleman's name!

Balsam of Peru

THE fragrant balsam imported into the United States as balsam of Peru is produced by a tree known botanically as *Myroxylon pereirae* Klotzsch. This tree is a native of the Republic of San Salvador on the Pacific Coast of Central America known as the Balsam Coast, a tract of land which formerly belonged to Guatemala. The coast was so named because originally balsam was the only article that was collected and shipped away from that region. The tree is found growing wild only along the west coast and in some localities it often occurs in dense forests. The balsam was long erroneously supposed to be a product of South America. In the period of Spanish rule, and by the commercial regulations then existing relative to the fruits of the coast, it was usually sent by the merchants here to Callao, Peru, and from there shipped to Spain, which accounts for the name of balsam of Peru, because it was considered indigenous to that region. The real place of its origin was known only to a few merchants.

At the present time balsam is shipped direct from points along the Balsam Coast which extends from Acajutla to La Libertad. The chief wealth of this coast is balsam and the trees yielding it are very numerous and apparently limited to one species, for in no other part of the coast, seemingly identical in soil and climate, are natural grown trees met with. Latterly the tree was introduced into tropical Africa and into the East Indies. The balsam tree is said to thrive very well in Kamerun in West Africa. A number of small experimental plantations have been started, and it is believed that a very profitable balsam industry will soon be developed there. It was planted as early as 1861 in Ceylon, and with complete success. A considerable quantity is yearly collected from trees which were planted near Calcutta, India, and Central America balsam trade is now receiving some competition from these points.

The manner employed by the Indians of the Balsam Coast in collecting the resin is very crude. Incisions of from nine to ten inches long and about two inches wide are made in the bark of the trunk. The areas from which the bark has been removed are wrapped with rags, and the tree being previously heated by a brisk fire around it, or by means of torches, exudes a gummy substance which is absorbed by the rags that are allowed to remain on the naked wood for a few days, when they are removed and placed in a pot of boiling water, which separates the gum from the rags. They are taken out before the water cools, and the resin, which has a greater density than water sinks to the bottom and is collected after the water is poured off. The rags are removed from the water while they are still hot and submitted at once to heavy pressure for the purpose of obtaining the balsam still attached to them.

The balsam is imported in large earthen-ware pots of a pear-shaped form partly covered with basket work, or in tin canisters. The balsam is a thick treacly-looking liquid, with a fragrant aromatic odor and taste. It is used in medicine as a stimulant, and also for making spills for lighting candles in churches and for torches.

The amount and value of imports of balsam of Peru from Central America during the past seven years have been as follows:

Year.	Amount Pounds.	Value.
1905	29,835	$17,114
1906	15,747	10,848
1907	15,303	11,817
1908	28,021	26,171
1909	25,843	24,217
1910	50,363	49,132
1911	37,910	47,840

The tree, which yields the commercial balsam, is about 45 feet in height, and from 12 to 18 inches in diameter at the base. The trunk often grows to the height of from 6 to 9 feet before it puts forth any branches. The wood is of a close grain, handsomely veined, nearly of a mahogany color, but redder. It has a very agreeable odor, which it retains for a long time and takes an excellent polish. Balsam wood is highly esteemed for cabinet work, but is rarely to be obtained, since the trees are seldom felled for the wood they yield.

The Canadian Arctic Expedition

THE Canadian Arctic Expedition has met with a series of misadventures, culminating in the unpremeditated separation of its leader, Vilhjálmur Stefánsson, with six of his men, from the rest of the "northern" party on board the "Karluk." It appears that this vessel spent most of August and September drifting helplessly in the ice off the arctic coast of Alaska. On September 20th, believing the ship fast for the winter, Stefánsson and a small party went ashore on a shooting expedition. While they were thus engaged the "Karluk" went adrift in a violent northeast gale, and has not since been heard from. Rumors are now rife of dissensions aboard the "Karluk" prior to this occurrence, but the hypothesis that the leader was intentionally abandoned can hardly be taken seriously. Stefánsson reports that he will proceed eastward to Herschel Island, after leaving an ethnologist and two Eskimos at Harrison Bay to study the natives of that region. During the winter he intends to make extensive surveys in the Mackenzie delta, and sledge journeys northward over the sea ice, possibly as far as Banks Land or Prince Patrick Island.

Kammerlingh Onnes—Nobel Prize Winner

FOR forty years past Kammerlingh Onnes has been spending his working life in a laboratory specially called into being for the production of the lowest temperatures attainable. For nearly twelve years there has been one goal before him: to liquefy the last gas which still resisted the greatest cold as yet experimentally produced. This gas was, as our readers know, helium.

A succession of workers, from Cailletet and Pictet (who were the first to liquefy alleged "permanent" gases) down to Dewar, who liquefied hydrogen, had carried off brilliant victories in this field of science, but one gaseous element of our planet still refused to yield to all endeavors to evidence it in the liquid form: helium.

In his cryogenic laboratory at Leyden Kammerlingh Onnes first attacked the problem from the point of view of theory. When his mathematical investigations were complete, he started out on the decisive experimental work.

By an ingenious arrangement of successive temperature drops or "cascades," he first produced a temperature of —90 deg. Cent. by means of liquid methyl chloride, then —105 deg. to —165 deg. Cent. by means of ethylene. Liquid oxygen then gave him temperatures extending from —183 to —217 deg. Cent. Hydrogen furnished the next step down to —253 to —259 deg. Cent. Not until this point was reached did the actual operations with helium begin. It was compressed to over 75 atmospheres and cooled in a bath of liquid hydrogen, and at —259 degrees the helium condensed to a bluish liquid, whose temperature, on boiling, fell to —271 deg. Cent. This is only two degrees above the absolute zero which, according to theory, is the lowest temperature attainable by any means whatsoever.

Calculations made by astronomers and physicists show that the temperature of interplanetary space is about —269 deg. Cent., a degree of cold which has thus been exceeded in the laboratory.

At these extremely low temperatures matter no longer behaves as at ordinary temperatures. The electrical conductivity of metals approaches infinity.

To produce these extremes of temperature it is necessary to work with minute quantities of gas and to use excessively fragile and delicate apparatus.

The estimation of the temperature obtained by the liquefaction and evaporation of helium is somewhat arbitrary, for a reliable gas thermometer cannot of course be found for these conditions. The only means that remains for gaging the temperature is the use of approximate formulæ and extrapolation.

There would therefore seem to be no gas left on the liquefaction of which physicists should have spent their efforts. However, in the upper atmosphere of the sun a new element has been discovered, coronium, whose spectral line appears in the light of the solar corona. It is probable that this element exists, though it has never been isolated in the atmosphere of the earth. Some day this may be accomplished, and the problem of liquefaction will arise anew.

"Little Holland" has every reason to be satisfied with the distribution of the Nobel prizes. In 1901, the first year they were awarded, a Dutchman, Prof. van't Hoff, received the chemistry prize. The next year Prof. Lorentz and Prof. Zeemann shared the science prize. The following year again the science prize was awarded a Dutchman, Prof. Vander Waals. In 1904 Prof. Asser received the peace prize, and this year we once more congratulate Holland on the trophy won for it by Kammerlingh Onnes.

Kammerlingh Onnes, winner of the Nobel prize in physics for 1913.

To Our Subscribers

WE are at the close of another year—the sixty-ninth of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year.

To those who are not familiar with the SCIENTIFIC AMERICAN SUPPLEMENT a word may not be out of place. The SCIENTIFIC AMERICAN SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

How Hollow Steel Piles, Compressed Air and Concrete are Employed to Make a Foundation

RAPIDITY of building construction is of primary importance in every city of metropolitan size. When real estate is sold at the rate of several hundred dollars a square foot it is self-evident that time is indeed money. The delay of a few days in completing a structure may deprive the owner of the chance of earning thousands in rental money. Because of the excessive depth of an open caisson, the completion of a foundation may be delayed for months. Hence the building may not be completed until the renting period has passed and the owner must wait an entire year before he can expect any financial return on his investment.

Because rapidity is so essential in city building construction the method of first sinking an open pit to rock in providing a foundation has been displaced to a large extent by a system in which heavy hollow steel piles are employed in clusters to support a building. The hollow piles are driven through quicksand to rock, cleaned out and ultimately filled with concrete.

In this method of constructing foundations, which is illustrated on the opposite page, hollow steel piles are driven in the well known manner down to solid rock. The steel pile sections vary in length from 20 feet to 22 feet, and in diameter from 12 inches to 24 inches. If the ground is to be penetrated to a depth greater than 22 feet, the sections of piling are connected by means of a sleeve in such manner that a watertight joint is formed. Under a pressure of 150 pounds to the square inch a jet of compressed air is then employed to blow out the earth and water contained within the shell. A spouting geyser of mud rising sometimes to a height of 150 feet, and occasional large pieces of rock blown up from a depth of 40 feet below the ground, bear testimony to the terrific force of the air blast.

When the shell has been completely cleaned out by means of the blast of compressed air, the exposed rock can be examined by lowering an electric light. Steel sounding rods are employed to test the hardness of the rock and to detect the difference between soft and hard bed rock. After the piles in each pier have been cleaned out, they must be cut off at absolutely the same height —sometimes a very difficult task when there is little room. The oxy-acetylene torch is used for the purpose, the intensely hot flame cutting off the steel almost like butter at the exact elevation desired.

The hollow shell is next filled with concrete reinforced by means of long two-inch steel rods, sometimes fifty feet in length. On clusters of these concrete-filled piles, the weight of the building is supported.

That this method of constructing foundations is indeed rapid, the story of the work at 145-147 West Twenty-eighth Street, New York city, proves. Rock was located 38 feet below the curb. The material above it was clay and water-bearing sand. Structural steel was due in three weeks, but the completion of the cellar was still ten days off. The steel pile foundation method offered the only solution of the problem. Specifications were drawn which called for eighty-five twelve-inch steel piles, driven to rock, blown clean by compressed air, and filled with concrete, reinforced with two-inch rods. Despite various obstructions on the ground (shoring of neighboring buildings and the like) the driving was started on June 30th. The excavator was still taking out his runway while the rear half of the lot was completely driven. After he had left the ground, a compressor was set up, and the first pipe was blown on July 7th. Three days later all driving and cleaning had been completed. During the following two days all the piles were filled and capped. In a word, the entire foundation had been completed three days before the expected arrival of the steel.

Such rapid work is not unusual with the steel foundation method. On another contract, work was completed not in the three months stipulated, but in exactly one month and a half, during which brief time all the excavation had been done, including sheeting, shoring, pile-driving, the mounting of concrete girders to carry the wall, and capping of the piles ready to receive the grillage.

Sometimes difficulties are encountered which would prove all but insurmountable and certainly hopelessly expensive with other methods. Thus in carrying out the one contract, water was found twelve feet from the curb. Two running streams had intersected at that point. The piles were simply sunk through the stream to rock bottom without any difficulty.

The excessive cost of open pit work has sometimes made it impossible to build twelve or fourteen-story buildings in many sections of the city of New York. The steel pile has, however, made steel building construction profitable.

The carrying capacity of a steel pile is enormous. On a single 12-inch steel pile one hundred tons can be safely maintained. Piers containing sixteen piles have been used, and loadings up to 1,300 tons are not unusual.

Naturally the question arises: Do the steel piles deteriorate in time? The question has been answered over and over again by the piles themselves. After a service of fifteen years the steel foundation piles were removed from the site of a building which now stands at the northwest corner of Wall and Nassau streets, in New York city. They showed practically no deterioration. The oxidation on the outside was almost negligible.

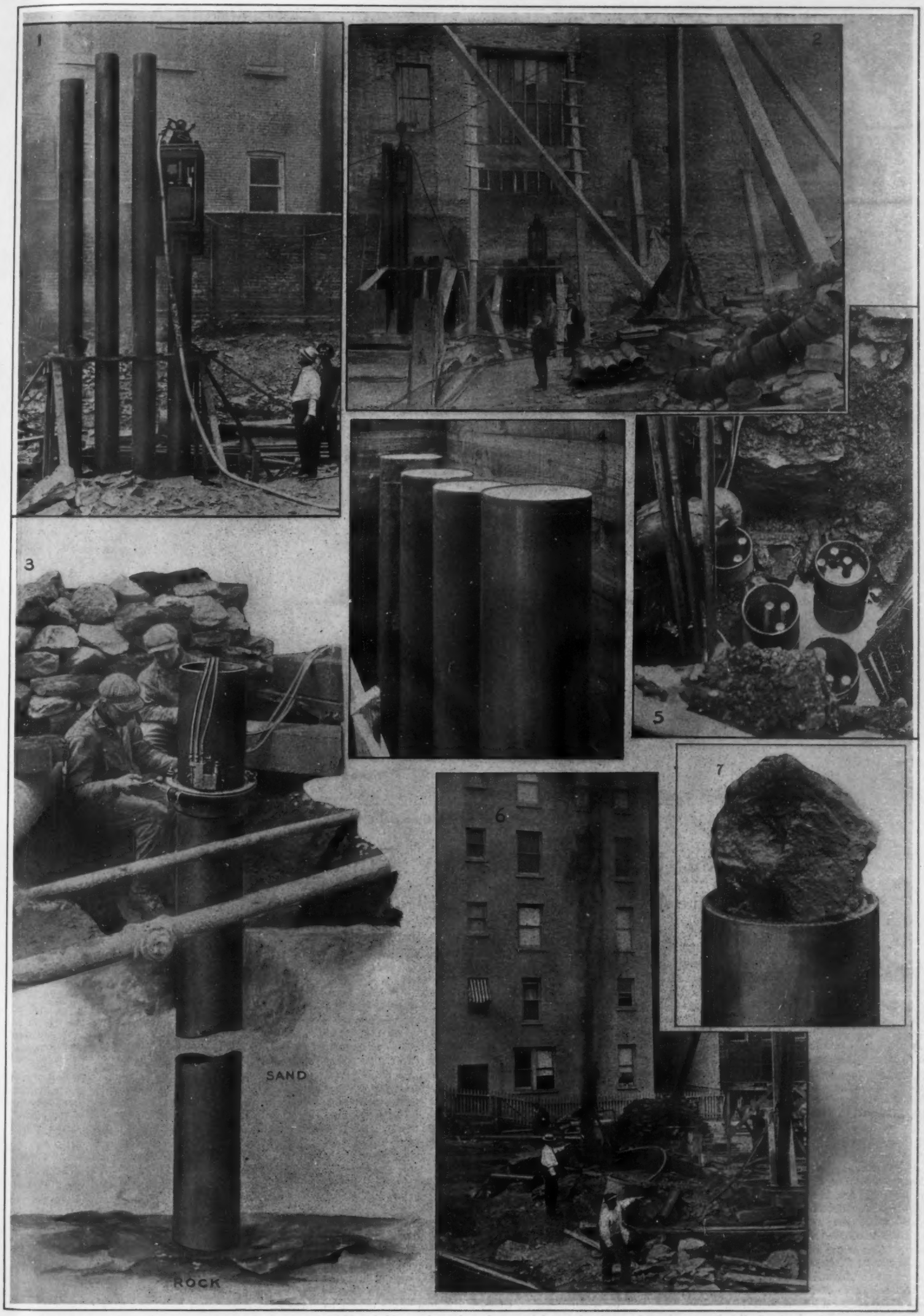
New York's New Fire Alarm Box System

AFTER work extending over two years, Mr. Leonard Day, chief of the Fire Alarm Telegraph Bureau, and Mr. E. A. Faller, telegraph expert of the Fire Department, have devised a fire alarm box which has been dedicated to the use of New York city without royalty, and it is expected that the cost under competitive bidding, will not exceed $45. The price of fire alarm boxes during the past several years under competitive bidding has run from $75 to $175 each. The average price has been $125 each. The estimated saving, therefore, will be $80 per box. The Fire Department experts have finished their box just in time to meet the needs of the city, as only six per cent of the boxes are modern, the rest being obsolete, and many being in an unsafe and even dangerous condition.

In view of the fact that the new Fire Alarm Telegraph system, including the isolated central stations, cables and connections will require the installation of fifteen thousand new boxes in the next five years, it is estimated that the saving to the city through the work which has just been completed will be in round numbers $1,200,000.

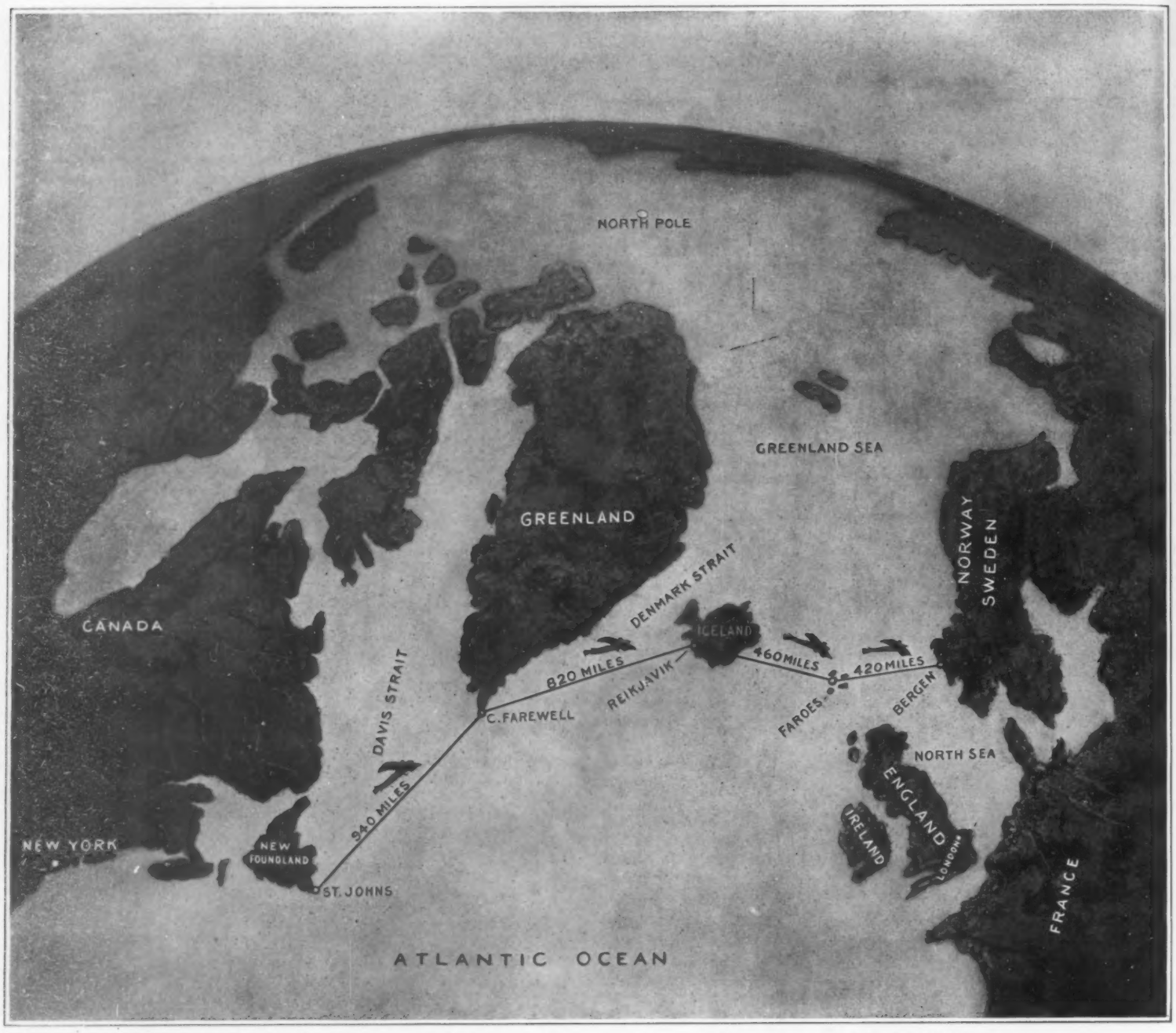
Exterminating Rats

A REPORT from M. de Kruyff of the Dutch Agricultural Bureau at Buitenzorg, Java, points the way to real success in rat killing. He tried the modern method of giving a contagious disease to one rat in the hope that all would die. This proved useless. Finally, de Kruyff hit upon a novel use of carbon disulphide. All visible rat holes were first stopped with earth to ascertain which holes were inhabited, for the inhabited holes were found reopened on the following day. Half a teaspoonful of carbon disulphide was poured in each of these holes and, after waiting a few seconds to allow the liquid to evaporate, the mixture of vapor and air was ignited. The resulting small explosion filled the hole with poisonous gases and killed all the rats almost instantly.



1. Driving the hollow steel piles down to bed rock. 2. The piles are about twenty-two feet long. If great depths are to be reached, sections of piling are joined together by means of a sleeve. 3. Pile being cut to proper level by means of oxy-acetylene torch. 4. A cluster of piles, cleaned out, filled with concrete and cut off flush by means of the oxy-acetylene flame. 5. Concrete piles which have been sunk to rock bottom and in which two-inch steel rods have been inserted to act as reinforcement for the concrete which will eventually be poured in. 6. Cleaning out a hollow steel pile by means of compressed air. A geyser of mud always appears. 7. The steel pile is easily forced even through the soft upper layers of bed rock. Sometimes very large pieces are blown up into the air by the blast of compressed air.

How a foundation for a modern building is constructed with the aid of hollow steel piles, compressed air and concrete.



Map of the North Atlantic Ocean, showing the points for way stations and distances in an aerial relay flight to Europe.

Way Stations for a Relay Flight to Europe

How the Atlantic Could Be Most Easily Crossed in an Aeroplane

By Henry Harrison Suplee

WHO can doubt that within a comparatively short time one or more human beings will have traveled from America to Europe, or the reverse, through the air? Whether this journey is first to be made in a machine which is lighter or heavier than the air through which it moves, does not yet appear, and it seems as if this point depends more upon the man than upon the machine. The remarkable trip from Paris to Warsaw and return, by Brindejonc des Moulinais, was made in an aeroplane; while the latest Zeppelin model is specified to have the ability to remain in the air for three days, and to have a speed of sixty miles an hour. Either machine should be rendered capable of making the sixteen hundred miles between Newfoundland and Ireland within a period estimated at from thirty to forty hours.

The elements of difficulty in the undertaking are comparatively few in number, and of a nature capable of critical investigation and solution on land, with one or two exceptions; always assuming that sufficient funds are available. For the aeroplane the most important thing is the assurance of the reliability of the motive power; for the dirigible it is probably the maintenance of the tightness of the envelope, and the consequent assurance of the ability of the machine to remain in the air for a long enough time.

For both machines, however, the human element forms one of the indeterminate features; the other one being the possibility of being carried far out of the way by reason of fog and by air currents.

Assuming that the problem of motive power for the aeroplane is capable of solution either by improvements in the design of the engine and extreme care in its construction, or by the duplication of the motive power machinery in such a manner that the navigator may shift immediately from one engine to the other; and accepting what is already believed to have been accomplished with regard to the length of time which a dirigible can be maintained afloat, we come to the two indeterminate features already mentioned. There is no doubt that the necessary crew could remain comfortably enough in the car of a Zeppelin of recent type for the time required for the Atlantic crossing, but it is also evident that it would be a most severe strain upon human endurance to stay in the cramped quarters of an aeroplane for the period required for the crossing, especially under the inevitable conditions of mental activity.

If we turn for a moment to other and far more highly developed machines for transportation, we find that no thought is given to the imposition of any such strain upon the operator, and that it is assumed without question that both machine and man have very definite limitations. High-speed railway trains change both engine and driver every three or four hundred miles, while on ocean steamers, where the motive power cannot be relieved, a sufficient number of men is provided to divide the labor into watches giving ample opportunity for rest and recuperation.

With but few exceptions, those who have discussed the problem of crossing the Atlantic through the air have felt themselves bound by the precedent of the steamship, and assumed that a continuous and uninterrupted voyage is a necessity. It has already been pointed out, however, that it is entirely practicable so to divide the trip as to bring its various portions well within limits of endurance already readily sustained both by the man and the machine.

If we take the attempt as being made from America to Europe, and examine the possibility of subdividing the trip, regardless of the lanes followed by the existing steamship lines, it is evident that a start from Newfoundland, passing by way of Greenland, Iceland, Faroe Islands, and Norway, would give opportunity for the division of the voyage into four sections, of not greatly differing lengths. Following the precedent of railway practice, and letting each section be traversed by men and machines in relay, it would not seem impossible to send a mail bag, for example, to Europe through the air, with the apparatus which is even now at our disposal. When this has been successfully accomplished it will be time enough to think about cutting out one or more of the way stations. This would mean, in the case of the aeroplane, the provision of four machines, including the one in which the start was made, and in the employment of as many operators. Doubtless such a method would not appeal to the sporting element, which regards the undertaking in the same light as a yacht race or similar event, but when considered wholly

(Concluded on page 498.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CORSET FASTENER.—ELIZABETH CALKINS, 516 N. 7th St., St. Joseph, Mo. This invention has reference to corset fasteners whereby the two parts of the corset can be securely fastened in such a manner that the fasteners can be easily and quickly loosened when it is desired to open and to take off the corset.

Pertaining to Aviation.

AEROPLANE.—G. E. HANES, 2518 W. 26th St., Denver, Colo. This invention relates to improvements in airships, and particularly to aeroplanes, and the object is to provide a structure in which the balancing mechanism is simplified for quickly restoring the balance or equilibrium to the aeroplane at any time.

Of Interest to Farmers.

POTATO SEPARATOR.—G. E. LUCE, 132 Sound Ave., Riverhead, N. Y. The purpose here is to provide a structure which will separate the potatoes into a plurality of grades, and at the same time shake out or remove the dirt and dust. The device may be continuously operated and will discharge at different points different sized potatoes.

ELECTRIC REGULATOR FOR INCUBATORS.—C. C. CARTER, Route 2, Chapin, Ill. This invention provides a regulator arranged to maintain a uniform temperature within the incubator when supplied with a heating medium of an approximately uniform temperature, and irrespective of the temperature of the surrounding air.

DRAFT EQUALIZER.—E. R. SPELLMAN, Box 30, Walla Walla, Wash. The inventor provides an equalizer by means of which five draft animals may be coupled together for pulling a plow and so arranged that the draft will be equally distributed, and the swingle-trees will be so balanced that the draft animals will pull in proper position alongside each other and with but one animal in the furrow.

Of General Interest.

SANITARY HOLDER FOR SHADE GUIDES.—G. L. GRIER and F. L. GRIER, care of the L. D. Caulk Co., Milford, Del. The object of this invention is to provide a device for holding samples of cement that are to be used as shade guides so that the latter may be in a moistened state and instantly ready for use in determining the shade of cement to be used in filling a tooth.

ORE FEEDER AND SAMPLER.—W. L. MOREHOUSE, 311 Wyoming St., El Paso, Tex. The invention relates to ore feeders and samplers, and the object is to provide one with a tube having openings, and outer spiral conveyer members on the tube, for conveying the material to the openings, so that when the tube is rocked some of the material will fall into the tube every time the tube is disposed with its openings upward, there being spiral conveyor members in and secured to the inner sides of the tube for conveying the material through the tube as the tube is rocked.

HAND BAG AND THE LIKE.—A. H. F. SCHLIECKER, Vinita, Okla. The invention relates to improvements in hand bags, purses, satchels, etc., and more particularly to the combination of a frame, and a body of fabric, leather or other material associated with the frame and having a thickened edge portion, the frame having a part clamped upon the thickened edge portion.

CHANGEABLE LETTER SIGN.—CELIA M. KINNEY, care of C. M. Kinney & Co., 3 W. 29th St., New York, N. Y. Among the special objects of this invention is to provide means whereby the names of words which make up a bulletin board or directory for an office building or the like, may be readily changed or lines interpolated between two others in place and close together without disarranging the letters of the contiguous lines.

COMBINATION ICE BAG, WATER BOTTLE, AND FOUNTAIN SYRINGE.—C. J. BARENPOHL, 356 Taylor St., W. New Brighton, S. I., N. Y. The invention relates to rubber goods and has particular reference to certain details of construction of water bags or bottles whereby a simple device is better adapted for various purposes than other devices now commonly in use. It produces a container of flexible waterproof material, such as rubber or rubber composition, the same having a comparatively large mouth adapted to be closed by a removable and reversibl closure.

ADJUSTABLE HOLDER FOR LAMINATED FORMS.—L. R. CARROLL, Charlotte, N. C. The purpose here is to provide a self radius striking form for bending and gluing together two or more pieces of wood to any radius desired, and wherein means is provided for holding the strips in the proper shape, the said holding means being adjustable to permit the formation of an arc of any radius.

VARNISH.—A. KUEGEL, 628 Columbus Ave., Sandusky, Ohio. An object here is to form a clear varnish which will not be subject to "crawling" or "chilling;" which will adhere uniformly to glass, metal or wood; which will not discolor anilin or other dyes, and which will mix with bronse powder without decomposition or discoloration.

Hardware and Tools.

SAW.—J. E. O'NEILL and W. G. MENIHAN. Address James O. Sebring, Atty., Corning, N. Y. This invention relates to saws and particularly to butchers' saws, the aim being to provide a saw with means whereby a removable blade may be readily and quickly attached and detached, the object being further to provide such means as will obviate the necessity for the use of extra tools.

OILER.—K. A. BOGGS, 521 South 12th St., Fort Dodge, Iowa. The invention relates to improvement in oil cans designed for lubricating purposes, and the object is to provide an oiler consisting of few parts which are readily assembled and taken apart, and one in which no screw-threads are used to connect the several parts.

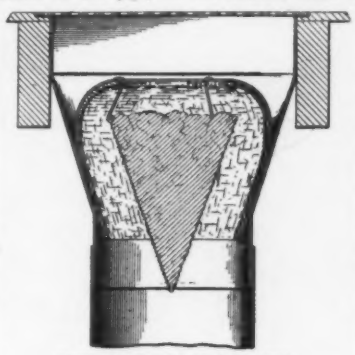
IMPLEMENT FOR DESTROYING REVENUE STAMPS ON BEER CASKS.—C. WEHNER, Sheridan, Wyo., general delivery. Revenue stamps are commonly applied to beer casks by pasting them on the metal bushings into which faucets or spigots are driven for drawing off the contents. This implement is adapted for cutting out the central portion of such stamps so that it may not be forced into the casks when the spigots are being driven into the bushings.

SPRING HINGE.—O. KATZENBERGER, care of Lawson Mfg. Co., 215 Huron St., Chicago, Ill. The object here is to provide a structure in which one of the heads is connected with the spring so as to wind the same, and is arranged with means for permitting a free rotation of the head while positively preventing any removal thereof.

Heating and Lighting.

GAS CUT-OFF.—E. T. THAYER, JR., 1507 Wilson St., Charleston, W. Va. This invention is an improvement which provides a cut-off which will automatically close when the pressure falls below a predetermined point, and which will be held closed by the pressure until it is again opened.

DUST CATCHER FOR AIR PIPES.—J. W. YOUNG, care of Turley & Turley, Goodbar Bldg., 128 N. Court Ave., Memphis, Tenn. This invention relates more particularly to a dust catcher to be fitted in an air pipe leading to or from a hot air furnace. The device is concealed in the pipe, as for instance below a



DUST CATCHER FOR AIR PIPES.

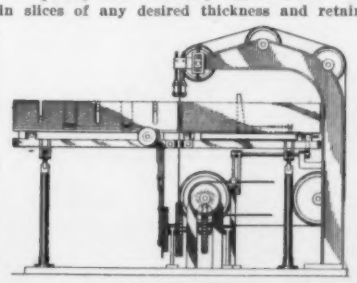
hot air register. Cotton or like fibrous dust catching material is held in the catcher in a manner permitting its being removed or renewed. The engraving represents a vertical section, showing the same arranged in connection with a hot air pipe and register.

MINER'S LAMP HOLDER.—N. FRIEBAND, 215 W. Coal St., Shenandoah, Pa. This invention has reference to miners' equipment and has particular reference to a form of holder or bracket designed as a permanent attachment to a miner's cap for the purpose of detachably holding a well known type of oil lamp.

Machines and Mechanical Devices.

CLOCK.—G. R. NORDLING, 4213 8th Ave., Brooklyn, N. Y. This clock has a hollow terrestrial globe as a casing for the works, the last including the usual mechanism with an arbor in which is mounted another arbor, which rotates in twenty-four hours by gearing connecting the arbors. Around the globe is a band with day and night hours thereon. Any place on the terrestrial globe may be ascertained by the markings on the band at any time. Means provide for determining the time along any given longitude.

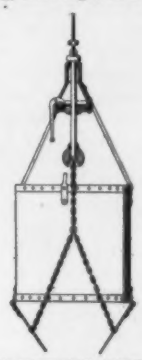
MEAT SLICER.—L. LINKIEWICZ, Box 40, 203 Montrose Ave., Brooklyn, N. Y. This inventor provides an improved structure which will quickly and uniformly cut or slice meat in slices of any desired thickness and retain



MEAT SLICER.

the same substantially in a normal position during the slicing operation without exposing the sides of the slices to the air, and so that the finished piece of meat will remain substantially in its original shape though in slices.

SELF-DUMPING BUCKET.—R. W. CATCHING, Fairview, Mont., care of U. B. & Coust Co., Memphis, Tenn. The bucket and the dumping doors are both connected with the hoisting cable, so that while the bucket and its contents are suspended during transportation or hoisting, the weight of bucket and con-



SELF DUMPING BUCKET.

crete in the bucket will hold the dumping doors closed, these doors being at such time directly connected with the hoisting mechanism, and wherein means is provided for clamping the bucket to the hoisting mechanism, after it has reached the place of disposal and has been lowered to it, to cause the bucket to move relatively with respect to the doors, whereby to dump the load.

Railways and Their Accessories.

LOG STAKE.—B. T. HARROP, Winnfield, La. This inventor provides a stake for holding logs in piled or superposed condition on a car or other support, so arranged that the stake will fall by gravity below the surface of the bunk commonly used on railroad cars for transporting logs, wherein the stake is so arranged that it will operate from the side opposite that from which the car is being unloaded, and wherein the mechanism is inclosed within the steel walls of the bunk, thereby preventing injury from the logs during loading or unloading.

CLAMPING DEVICE.—J. W. REESE, 36 W. 7th South, Salt Lake City, Utah. The purpose of this inventor is to provide a mechanism especially adapted for use with ties other than wooden ties, and wherein means is provided for holding the rail firmly to its seat on the tie, capable of being released when desired, and without the use of spikes and the like.

Pertaining to Recreation.

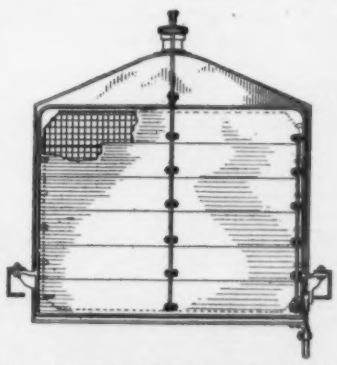
ROUNDABOUT.—N. J. SHAMBOY, care of Lewis Nahemow, 302 Broadway, New York, N. Y. The object here is to provide an amusement apparatus, in which each car has a planetary movement, and the several seats on the car travel in different epicycloidal or in hypocycloidal paths, thus giving the occupants highly enjoyable and sensational rides.

Pertaining to Vehicles.

HOSE CLAMP.—C. E. EDWARDS, Rockville Center, N. Y. This invention relates more particularly to a structure particularly adapted for use on automobiles for insuring tight connection of a hose with the radiator. The principal object is to provide a simplified structure adapted to exert pressure uniformly on the hose, whereby wrinkling or cracking of the same is prevented when the parts are in proper relation.

COMBINATION SLEIGH AND WHEELED VEHICLE.—W. E. WISE, 421 Rural Ave., Williamsport, Pa. This inventor provides a wheeled vehicle with runners mounted so as to be swung to a position to cause the wheels to work onto the runners. He also provides a novel means of mounting the wheels to better adapt the vehicle to the arrangement of sleigh runners.

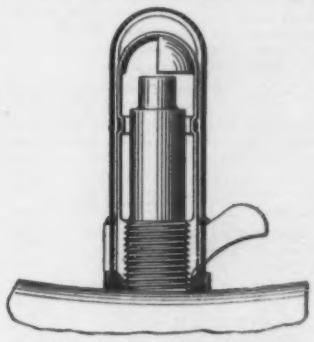
WIND SHIELD FOR AUTOMOBILE RADIATORS.—A. HOILAND, Nome, N. D. The purpose in this instance is to provide a device which may be operated either by hand or automatically for shielding the radiator from the



WIND SHIELD FOR AUTOMOBILE RADIATORS.

wind and therefore conserving the heat necessary to bring the engine to the best working temperature. The manual means provided for operating the wind shield is especially desirable in the case of a leaky radiator where the automatic means cannot be used. The engraving shows a front view of a radiator provided with the invention.

DUST CAP FOR TIRE VALVES.—J. LYNN, Alice, Tex. In carrying out this invention, the object is to provide a dust cap which will not only efficiently serve to protect a valve



DUST CAP FOR TIRE VALVES.

and its casing as well as exclude all dust therefrom, but which will obviate the disadvantage of caps which must be threaded in place, by providing a separable cap which will require but very few turns to remove or lock it in position by providing means to permit separation of the sections of the cap against means normally tending to clamp the cap in position.

SPRING WHEEL.—J. D. COLLIER, Seeley, Cal. This invention refers to improvements in vehicle wheels, and has reference more particularly to that class of spring wheel which comprises a plurality of shoes and resilient spokes so associated with the hub as to form a vehicle spring wheel. Means provide for preventing any lateral displacement of the felly relatively to the hub.

FOLDING CHAIR FOR AUTOMOBILES.—W. H. DOUGLAS, care of Healy & Co., 1652 Broadway, New York, N. Y. The object of this invention is the provision of a new and improved folding chair for use in automobiles, arranged to be completely out of the way when folded and to allow of quick and convenient setting up for use whenever desired.

Designs.

DESIGN FOR CARPET OR RUG.—J. O. PEGEL, care of G. S. Squire, 25 Madison Ave., New York, N. Y. Mr. Pegel has made four designs for a carpet or rug bearing the numbers 44,893, 44,894, 44,895, and 44,896, of which the first three are based on the plan of a broad border around the centerpiece, while the last has an extremely narrow square cornered border between which and the centerpiece is a large mass of blended scrolls and flowers.

DESIGN FOR CARPET OR RUG.—W. E. SAYERS, care of G. S. Squire, 25 Madison Ave., New York, N. Y. This designer has made four designs for carpet or rug numbered 44,901, 44,902, 44,903, and 44,904. All of these designs are distinguished by broad borders and compact massing of details in the field instead of a prominent centerpiece, except the first, which has within its borders a large centerpiece.

DESIGN FOR A RUBBER MAT.—E. HUTCHENS, Milwaukee, Wis. This design shows a plan and side elevation. The plan is made up of a series of triangles in rows, the series being composed of black and white stripes that represent gradually diminishing triangles within the outside one. The arrangement is very effective and forms a novel and attractive mat.

DESIGN FOR A GRAVE INCLOSURE.—H. H. ALTHOFF, care of Joseph Bermel, Middle Village, L. I., New York. In this ornamental design the grave inclosure is of oblong form, square cornered and the base somewhat broader than the top. Rough stone effect predominates on the exterior and the end is marked by the word "Mother."

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Way Stations for a Relay Flight to Europe

(*Concluded from page 496.*)

as a conservative engineering problem, the plan may well be examined upon its merits.

From St. Johns, Newfoundland, to Cape Farewell, Greenland, is a distance of nine hundred and forty miles, this being the longest leg of the trip, and one which might be very materially shortened if a satisfactory starting place could be assured on the coast of Labrador. From Cape Farewell to Reikjavik, Iceland, is somewhat shorter, being eight hundred and twenty miles. These two portions of the voyage, the first traversing Davis Strait and the second crossing Denmark Strait, are those in which the difficulties of fog are most apt to be encountered, although it is possible that the route may pass farther north than the region of dense fog.

From Reikjavik to the Faroes is four hundred and sixty miles, and from the latter it is four hundred and twenty miles to Bergen, Norway.

This makes a journey of twenty-six hundred and forty miles, divided into four fairly equal stages, permitting the difficulties of endurance, both of man and machine, to be reduced in far greater proportion, and bringing the question of fuel supply into altogether manageable shape.

It may be said that such a route is altogether undesirable because it begins and ends at wholly useless points, and follows unsuitable places *en route.* The great thing, however, at present, is to demonstrate the possibility of making the crossing at all, and this once accomplished, it is probable that important modifications would follow.

In any case it must be remembered that it is trade routes which create their own desirability. When all commerce with the Orient was conducted from Venice and Genoa eastward, the commercial importance of England was little greater than that of Iceland, and it was the sudden change in the face of Europe, after the new routes to India and America were opened, which placed the British Islands in the front of the commerce of the world. Facilities create traffic in all parts of the globe, and when the routes are established they can be depended upon to bring many changes in their train.

In the meantime it may be desirable to hesitate before demanding from the aeroplane and its operator feats of endurance which have never yet been asked of the locomotive engine or its driver; and be well satisfied that the North Atlantic is capable of division into practicable sections for aerial navigation.

Fighting with Dynamite and Electricity

(*Concluded from page 488.*)

the enemy. When the grenade is to be fired, an electric current is sent through the cable, whereupon the grenade is projected upward to a predetermined height (generally three feet), where it explodes and simultaneously discharges the four hundred projectiles in a horizontal direction, radially from the center, and parallel to the surface of the ground so as to sweep this in its entirety over an area of at least 900 square yards.

At a distance of 40 feet the projectiles will pierce a timber wall at least 4 inches thick, exerting mortal effects up to 96 yards. Hence this grenade partakes of the properties of the underground mine, explosive shell and shrapnel shell.

At the same time however it offers a number of conspicuous advantages. Since both the grenade and the cable are buried entirely in the ground, the mine field is hidden so completely as to make detection by the enemy altogether impossible. Moreover, the grenade, thanks to its special design, will always explode exactly at the height most advantageous for the explosive effects. Again, it invariably explodes with its longitudinal axis perpendicular to the ground, its four hundred projectiles being thrown out in all directions, parallel to the ground, so as always to insure maximum shooting effects. Very few projectiles will deviate from a horizontal direction. Finally, the grenade is, by a triple safeguard, fully protected against any premature explosion during transportation, and while being handled and installed. It may even be fired on with rifle balls at short range, without being caused to explode. The fuse can moreover be removed and inserted at any moment.

Aasen grenades are inserted into holes dug in the ground with the spade or pick or with a special drill. In undermining a road, the shells may be arranged alongside the wayside, 20 to 25 yards apart. Instead of connecting up all grenades of a given field in series and exploding them simultaneously, they may be arranged in several series, thus allowing a given mine field to be fired in several sections. The shells may also be provided in duplicate or in triplicate, so that after firing the first set, the fuses have only to be connected up to the next set of electric cables, in order again to establish the mine field.

Grenades once planted may remain in the ground for years without suffering any damage. If the mine field be tilled ground, it may even be used for agricultural purposes without incurring any danger.

The Great World Wireless Circuit

(*Concluded from page 488.*)

Suitable flanges permit the sections to be bolted together, end to end. Further, the ten-foot sections are themselves made up of two parts which are also bolted together, vertical flanges being provided for the purpose. The bolting up is done when the individual pieces are placed in final position. That is, the towers are erected piece by piece. Some of the sections used at other locations are higher than ten feet and have larger diameters than those at Belmar. Sections of large diameter are sometimes made up of four quadrant pieces provided with vertical flanges. The metal is comparatively thin, the parts being made of sheets pressed to shape, each piece flanges and all being absolutely without seam or joint. At least, this is the type of steel work being used in New Jersey.

The lower portion of a tower has a larger diameter than the upper, a tapered intermediate section being used to connect the two halves. At the very top, a wooden mast projects from the hollow steel. This mast carries the supporting arms, which in turn bear the weight and strain of the aerials. It is used as a help in construction from the time the work reaches the height of twenty or thirty feet. From this point on, it is hoisted up step by step as the construction advances; it is always to be seen projecting above the top of the steel work. The manner of hoisting it up from time to time is very interesting. A steel rope is temporarily attached to the uppermost horizontal flange of the unfinished tower, or runs over a sheave temporarily fixed at this point. In the latter case, the rope is carried down to some convenient point and secured. From the top of the tower, the rope passes down inside to the bottom of the wooden mast where it passes round a sheave and up the opposite side to the top of the tower again. Here it passes over a sheave and down the outside to a point near the ground where another sheave permits its direction to be changed to the horizontal. A hoisting engine winds in the horizontal section and thus effects a raising of the wooden mast. When the mast has been lifted the height of a single tubular section, a bar is passed through both steel and wood. At every one of its positions, the mast provides support by means of four radial arms for the raising and lowering of a kind of movable balcony. The balcony is moved up and down by the workmen on it, who operate the block-and-tackle arrangements which connect radial arms and balcony. Standing on the balcony, the workmen are able to do the hoisting and placing of steel pieces and also the bolting of them in final position.

The towers stand on heavy concrete foundations, but are not sufficiently strong to maintain rigid positions without external assistance. This is provided by

(*Concluded on page 501.*)

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means of an elaborate system of steel guy ropes secured to the towers on four sides and at various heights. At their outer ends, they are attached to heavy concrete blocks buried in the earth. It was thought that long steel guy ropes might vibrate closely enough in unison with the wireless "waves" to set up an interference. Consequently, the guy ropes have been broken up into harmless lengths. Where two lengths have to be joined, this is accomplished in such a way as to eliminate actual contact of rope with rope. Loops on either end pass through each other, but have interposed between them heavy pieces of porcelain. The blocks of porcelain are thus put under compressive stress which they are well able to endure, but are not permitted to undergo tension.

Both at Belmar and at New Brunswick, the colonnades of towers are one mile long; there is, however, a double colonnade at the latter point because of the number of aerials requiring support.

At Belmar are to be housed a considerable company of operators and the like. The company is putting up its own buildings for this purpose as well as for the more immediate necessities of the reception and transmission of messages. The two installations in New Jersey constitute a one-way station operating by long distance wireless with Wales only. At Honolulu, a two-way station is being constructed which will connect with San Francisco on the one hand and with Yokohama (or possibly Hong Kong) on the other.

Making Colored Photographic Reproductions With the Aid of Blue Prints

JOHN LEWISOHN of New York has invented a method of making colored photographic reproductions, in which the blue coloration in a blue-print is utilized as one of the primary colors.

A negative of a colored object is made on an ordinary orthochromatic photographic plate, using a yellow colored screen, in order to obtain the best color values. From such a negative, an ordinary blue-print is made, which blue-print will, of course, show up the different shade values in their proper proportions. This blue-print is then colored either wholly or in part, by applying red eosin and aurantia, or a mixture of the two, to modify the blue to form any of the spectrum colors, the blue coloration showing through the applied washes with more or less intensity depending upon the extent of the coating wash. Should it be desired to make all or any material portion of the print either red or yellow, or any other color, in which blue is not used, the blue of the blue-print is either wholly or partially dissolved by a weak solution of nitrate of silver, which will fix the colors, and, at the same time, will gradually bleach out the blue. Further, the blue-print may be washed with this solution, if it is desired merely to weaken the blue color of the object, after the eosin or aurantia has been applied, or a mixture of the two, to form any of the spectrum colors involved in these two primary colors. Should it be desired to restore the blue locally or entirely, or to darken the blue color, the blue-print is respectively touched up or bathed with a solution of ferric chloride, and this ferric chloride may be applied in stronger solution or in succession until that part of the object is practically black. Instead of painting or bathing the entire print in any one of these colors, certain spaces may be touched up locally in order either to darken or lighten those particular parts. In addition to this local treatment, the entire print may be submerged in either of these primary colors, or any combination of the same, to give the different color background and a different tint to the entire picture.

A Car for Subway Use.—Antoine B. Du Pont of Cleveland, Ohio, has secured patent No. 1,073,106 for a car adapted for subway use in which the car body extends downward between the trucks and a motorman's compartment at the end of the car body extends downwardly between the wheels of the truck.

NEW BOOKS, ETC.

OFFICIAL AMERICAN TEXTILE DIRECTORY. 1913. Compiled by the Textile World Record. Boston: Lord & Fagle Company. 8vo.; 624 pp. Price, office edition, $3; travelers' edition, $2.

The Directory contains reports of all the manufacturing establishments in the United States and Canada, and includes an index of the yarn trade with lists of concerns selling to or buying from textile mills.

AN INTRODUCTION TO ZOOLOGY. With Directions for Practical Work. By Rosalie Lulham, B.Sc. New York: The Macmillan Company, 1913. 8vo.; 457 pp.; illustrated. Price, $1.60 net.

A text book dealing with the common British invertebrates, with the needs of the higher classes of secondary schools held particularly in mind.

MAKING THE FARM PAY. By C. C. Bowsfield. Chicago: Forbes & Co., 1913. 8vo.; 300 pp. Price, $1.

The author endeavors to convey such diversified yet practical information as shall enable the farmer to find the path to success and larger profits. The aim of the instruction is "the best results with the least labor and the least waste."

FACTORY LIGHTING. By Clarence E. Clewell. New York: McGraw-Hill Book Company, Inc. 8vo.; 161 pp.; illustrated. Price, $2.

The subject of artificial lighting of factories is justly receiving increased attention as its importance is realized. At night and on dark days, when artificial illumination is necessary, much depends upon the nature of the light, its placement, and its candle-power. From the manufacturer's point of view, volume of work and quality of workmanship are directly involved; to the workman good light means reduction in eye strain and liability to accident, with increased comfort and ease of action. The supervisor's task is also greatly facilitated. The author proceeds from modern lamp types, installment, and switch control to a consideration of the specific needs of the office, the drafting room, the factory, the power-house, and the mill. There is a special chapter on machine tool lighting, and another devoted to maintenance and maintenance records. The work abounds in valuable diagrams, tables, and illustrations, and is an adequate and practically helpful guide that will be heartily appreciated by those who seek information upon any of the points with which it deals.

THE GAS ENGINE HANDBOOK. A Manual of Useful Information for the Designer and the Engineer. By E. W. Roberts, M.E. Cincinnati, Ohio: Gas Engine Publishing Company, 1913. 16mo.; 323 pp.; 85 illustrations. Price, $2.

The seventh edition of Roberts's well-known manual comes to us rewritten and enlarged. The progress in internal combustion engines has made this necessary. In so condensed a guide, perhaps the most important consideration on the part of its compiler is what to omit. This difficulty has been met quite as successfully as could be expected in such a case of compromise, and the reader may be tolerably sure of finding here all the primary and essential information enabling him to understand his motor and its vagaries. There is a rather large assignment of space given to the subject of testing, including an explanation of the calorimtery of gases.

CHRONIQUE ILLUSTRÉE DU CONCOURS INTERNATIONAL DE TÉLÉGRAPHIE PRATIQUE. Turin: Ferdinando Geronimi, 1911. Dessins par Telemaco Obè. 4to.; illustrated.

The distinguished head of the postal and telegraph systems of Italy sends us this souvenir of a notable convention. It records and describes all the interesting features of the *Concours International*, which was graced by the presence of numerous foreign dignitaries and representatives, and marked by exciting competitions among exponents of the various systems. The descriptions breathe an enthusiasm that evidences the international goodfellowship engendered, and the salutary and inspiring effects of an interchange of knowledge and an interplay of intelligences under such singularly auspicious circumstances. The volume is for the most part in French, and is lavishly illustrated.

MECHANICAL AND REFRIGERATING ENGINEERS' HANDY BOOK. By Otto Luhr. With Collaboration of E. T. Henius. Chicago: Wahl-Henius Institute, 1913. 8vo.; 893 pp.; 312 illustrations. Price, $5.

Experts of the Wahl-Henius and other institutes have joined forces in making this work of reference as complete and as up-to-date as possible. The needs of the refrigerating engineer have received particular attention. Under mechanical engineering, physics, electricity and magnetism, chemistry, steam and steam engines, turbines and internal combustion engines are included. The latter portion of the work is devoted to refrigeration, and here are presented the laws bearing on it, the properties of the chemicals used, the various systems and machines, and insulation. Electrical engineering is also touched upon, with heating and ventilation, pipes and pipefitting, and friction and lubricants. The information and tables of the latest publications are embodied in the text, including the last-issued steam table of Marks & Davis, and the newest ammonia table compiled by H. J. MacIntire. The numerous calculations with which the text abounds are illustrated by examples, thus giving the practical engineer an opportunity of going through the calculations at first hand.

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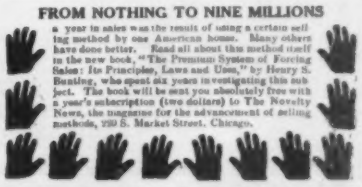

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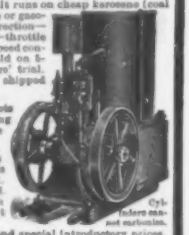

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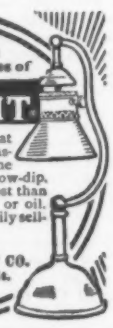

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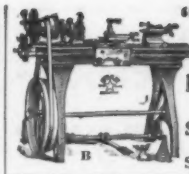
(12883) W. C. asks: I should be very pleased if you could inform me exactly how many pounds pressure there generally is in the envelope of a balloon. Is there any difference between a rigid and a non-rigid balloon, and does the size make any difference? A. The pressure of the gas in a balloon of any kind is closely the same as in the open air outside the balloon, at any altitude. If the pressure were greater in the balloon, the thin cloth cover of the balloon would burst and the balloon would drop to the earth.

(12884) H. V. asks: Would you kindly tell me if aluminium can be electro-nickel plated the same as iron, brass and copper, and is it done the same way? A. The method for coating aluminium with other metals, as given in Watt's "Electro-Plating" (which we send for $4.50) is first to remove the film of oxide of aluminium with which all aluminium is covered as soon as it is exposed to the air, by first immersing it in a solution of sodium carbonate—washing soda—till gas comes off freely, and then rinse in hot dilute hydrochloric acid, one part acid in 20 parts water, and finally immerse in a dilute solution of copper sulphate. A film of copper is formed upon the surface of the aluminium which adheres firmly and forms a base upon which other metals can be deposited in the usual way. There has been great difficulty in covering aluminium with other metals so that the coating will last.

(12885) L. C. asks: 1. What is the greatest known depth of the ocean, and where? A. In charting the ocean floor any area below 3,000 fathoms is called a deep. The Aidrich Deep in the South Pacific is one of these, in which three soundings of 5,022, 5,147 and 5,155 fathoms were made by the British ship "Penguin" in 1895. This is exceeded in depth only by the Challenger Deep, which lies between Guam and the Pellew Islands, where in 1899 the United States ship "Nero" sounded to a depth of 5,269 fathoms. This is the greatest depth reached by the sounding wire. 2. Are there any parts of the ocean so deep that, up to the present time, soundings have not established the correct depth? If so, where? A. There are no places known whose depth has not been determined by sounding. The popular notion that there are places whose depth cannot be sounded is entirely without foundation. The writer was shown a small basin a few hundred feet across in Penobscot Bay last summer, and was told that it had no bottom. He looked at it with interest, and wondered how intelligent people could believe such a story. 3. Are there any parts whose depths have not been charted for any other reasons? If so, where? A. All parts of the ocean bottom have not been charted, but surveys have been made over most of it. There may be in the neighborhood of volcanic islands, especially in the South Pacific Ocean and along the Asiatic coast of the Pacific, deeps as yet undiscovered. Sir John Murray's recen work, "The Depths of the Ocean," which we send for $7.50, covers the knowledge we have on this most interesting topic. It describes the methods and apparatus for sounding and the results obtained. One desirous of a knowledge of what has been accomplished should consult this valuable work.

(12886) E. F. O'K. asks: If one square inch of air is compressed one half, what is the pressure? A. If air is compressed to one half its volume the pressure is doubled. The atmospheric pressure is 14.7 pounds per square inch, as against a vacuum. This pressure does not affect a pressure gage when air is on both sides of the gage. For this reason the gage pressure will be 14.7 pounds when the air has been compressed into half its volume, since the gage reads zero before the air is compressed. The pressure as against a vacuum will be 29.4 pounds when the air has been compressed to half its volume. It is customary to call the atmospheric pressure 15 pounds per square inch, in round numbers, and at half volume the doubled pressure will be 30 pounds per square inch, as against a vacuum.

(12887) L. G. B. asks: If two bodies (say like planets) approach one another within the range of appreciable gravitation, what determines whether they will become permanently locked in orbital revolution, or whether they will be only somewhat deflected, and then pass on out of the range of gravitation? A. The problem which you propose is one of celestial mechanics. It is treated in a simple way in Young's "Manual of Astronomy," Chapter XI. We send the book for $2.50 by mail. It may be that this will suffice for your purpose. The general answer to all your questions is that the velocity and masses of the bodies are the factors in determining their final orbits. The problem is called the Problem of Two Bodies in Celestial Mechanics. A body falling into the solar system will revolve around the sun permanently if its velocity at the distance of the earth from the sun is less than 26.1 miles per second. This is called the parabolic velocity. If the velocity of approach is greater than 26.1 miles per second the bodies will not revolve around each other, but will go away into space again.



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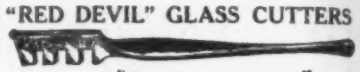

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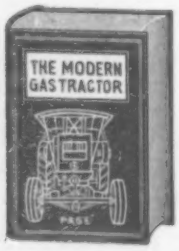

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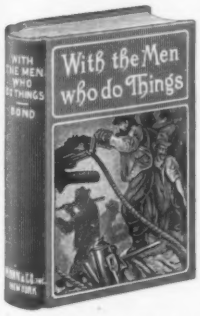

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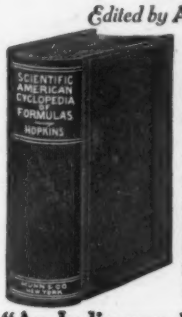

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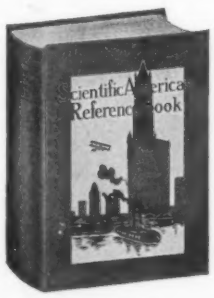

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